1990
Ambient Air Quality Report

State of North Carolina
James B. Hunt, Jr., Governor

Department of
Environment, Health and Natural Resources
Jonathan B. Howes, Secretary

Division of Environmental Management
A. Preston Howard, Jr., P.E., Director

Air Quality Section
Alan Klimek, Chief

September 1995

DEHNR

FOREWORD

This report is issued by the Division of Environmental Management of the Department of Environment, Health, and Natural Resources to inform the public of air pollution levels throughout the state of North Carolina. It presents the results of the monitoring that was conducted in 1990 to measure the outdoor concentrations of the following pollutants for which the U.S. Environmental Protection Agency and the State of North Carolina have established ambient air quality standards:

Particulate Matter	Sulfur Dioxide	Ozone
Carbon Monoxide	Nitrogen Dioxide	Lead

The data presented graphically and as statistical summaries, including comparisons to the ambient air quality standards. The report discusses the recorded data, seasonal variability of some pollutants, and the sources and effects of each pollutant. Data and areas exceeding the ambient air quality standards are identified. Factors which have contributed to those exceedances are also described. Data after 1990 are discussed in later reports.

A brief discussion of the ambient air monitoring program, including a description of the monitoring network, is provided. Acid rain data from the National Atmospheric Deposition Program/National Trends Network (NADP/NAN) for North Carolina is also included for 1990.

Additionally, current air pollution information is available 24 hours a day in four areas of the state through the use of the air quality index telephone numbers listed below:

Charlotte	703-333-SMOG
Durham	919-733-DATA
Fayetteville	919-486-9413
Raleigh	919-733-DATA

Additional copies of this report and the previous reports are available from:

Department of Environment, Health, and Natural Resources
Division of Environmental Management
Air Quality Section
512 North Salisbury Street
P.O. Box 29535
Raleigh, North Carolina 27626-0535

Comments regarding this report or suggestions for improving future reports are welcomed.

A. Preston Howard, Jr., P.E., Director
Division of Environmental Management

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REPORT

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My Fellow North Carolinians:

Air pollution affects us all. Maintaining excellent air quality is a challenge we face daily. From acid rain in our mountains to ozone problems in the Piedmont, North Carolinians must strive to identify and to prevent these problems to keep our air clean.

The Department of Environment, Health, and Natural Resources and four local air pollution control agencies measured ambient air pollution across the state. This information, together with information on amounts of air pollutants emitted by mobile and stationary sources, gives us the basis for regulations that will protect our state's air quality.

We are dedicated to maintaining and improving quality air in North Carolina.

Jonathan B. Howes, Secretary
North Carolina Department of
Environment, Health, and Natural Resources

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EXECUTIVE SUMMARY

In 1990, ambient air monitoring was performed by the North Carolina Division of Environmental Management (DEM) and four local air pollution agencies. A listing of these agencies is provided in Appendix A.

300,957 air quality measurements were made in 1990 for all criteria pollutants except lead. Data summaries, graphs, maps, and discussions of the reported data, as well as a description of each pollutant, are presented.

Particulate Matter (PM) of two different types was collected in North Carolina during 1990. One type, Total Suspended Particulate (TSP), includes particles in a size range of 0.3 micrometers to about 100 micrometers. The other type of particulate matter, Particulate Matter-10 micrometers (PM-10), includes particles in a size range of 0.3 micrometers to 10 micrometers (aerodynamic diameter). A micrometer is approximately 1/25,000 of an inch. Two exceedances of the state TSP ambient air quality standard (150 $\mu g/m^3$) were recorded in 1990. These were not affected by exceptional events. These exceedances occurred at the Forsyth County, Corporation Parkway site.

On July 31, 1987, the federal Environmental Protection Agency (EPA) replaced the national TSP ambient air quality standard with a national standard for PM-10. Subsequently, the North Carolina PM-10 standard became effective July 1, 1988. Twenty sites collected PM-10 data in 1990. Of the 873 samples collected, there were no exceedances of the PM-10 National Ambient Air Quality Standard. A continuation of the gradual phase-in of more PM-10 monitoring to replace TSP monitoring will be seen in 1991. Based upon the average PM-10 to TSP ratio, there is a likelihood that some of the measurements at former TSP sites will exceed the PM-10 annual standard when PM-10 monitors are installed.

Carbon monoxide (CO) is the most abundant air pollutant in North Carolina. More than 80% of the CO is believed to be emitted by motor vehicles. The most likely areas to have excessive CO concentrations are the larger cities where there are more cars and congested city streets.

In Charlotte, one exceedance of the 8-hour standard was reported in 1990 at two sites, the first reported exceedance since 1985. The motor vehicle Inspection and Maintenance program, in operation in Mecklenburg County since December 1982, deserves some of the credit for this CO improvement.

There were two exceedances of the 8-hour standard in Durham County in 1990 and no exceedance in Wake County. This is a decrease from the total of four 8-hour average CO exceedances in the Raleigh and Durham areas in 1989. The combined effects of newer cars in the vehicle fleet, traffic control strategies, and the Wake County Inspection and Maintenance program have helped to reduce the number and intensity of CO exceedances from that of earlier years. Ambient monitoring data is continuing to be collected and evaluated to confirm this improvement.

Ozone (O_3) is a major component of smog and forms when numerous chemical compounds react in the presence of sunlight. Hydrocarbons and nitrogen dioxide are important reactants in the formation of ozone; therefore, the main emphasis in control of ozone has been to control hydrocarbon emissions. There were a total of 69 exceedances of the ozone air quality standard in 1988 and six exceedances in 1989. Three exceedances of the ozone air quality standard occurred in North Carolina during 1990.

As of 1990, Mecklenburg was the only county designated as an ozone nonattainment area. In 1988, at three Mecklenburg County ozone sites, 24 values exceeded the ambient air quality standard. In 1990, the air quality standard was exceeded one time at one site in Mecklenburg County. Hydrocarbon control strategies are being used in Mecklenburg County to reduce the ozone problem. Six exceedances at the Granville County Butner ozone site in 1988 and three exceedances in 1989 establish the need for development of ozone control strategies in Raleigh and Durham. In 1990, there were no ozone exceedances in Raleigh and Durham.

In 1988, Winston-Salem, Fayetteville and Wake Forest monitors reported at least three exceedances each. Mecklenburg County, Raleigh and Durham, and Winston-Salem and Greensboro areas were designated as not attaining the ambient air quality standards. Raleigh/Durham and Winston-Salem/Greensboro areas air quality has improved enough that attainment status is being requested but many control strategies are needed to assure continued attainment. These areas, as well as several others, are being carefully watched. These data indicate that ozone control plans may be required for the 19 counties near the monitors that have reported exceedances. In 1990, two exceedances were reported by monitors in Forsyth and Guilford Counties.

To help develop a strategy to deal with the O_3 problem, a special monitoring study began in 1989 for Charlotte and Raleigh for nitrogen dioxide (NO_2) and nonmethane organic carbon (NMOC) compounds. NO_2 and NMOC are precursor pollutants which react together to form ozone. **Ozone has become the most widespread and most serious criteria air pollutant problem in North Carolina.**

Sulfur dioxide (SO_2) ambient concentrations did not exceed the ambient air quality standard at monitoring sites during 1990. Overall, sulfur dioxide values are well below state and federal standards. The sites measuring the highest concentrations are near major sulfur dioxide sources such as those burning large quantities of fossil fuels and manufacturing sulfuric acid. Remote and rural SO_2 concentrations are very low, frequently near the lower measurement capability of the monitors. SO_2 data continues to be collected and evaluated to aid new and expanding industry in the permitting process.

Nitrogen oxides (NO_x) are emitted into the atmosphere as a result of burning fuel by both stationary sources and motor vehicles. These nitrogen oxides, particularly nitric oxide, convert to nitrogen dioxide (NO_2) in the atmosphere. Nitrogen oxides play an important role in the

formation of ozone. No exceedances of the nitrogen dioxide ambient air quality standard have been measured at these sites or at other sites in recent years. NO_x monitoring was performed in 1990 in Charlotte, Raleigh, and Winston-Salem as a part of data gathering for development of control strategies for ozone nonattainment areas.

Lead (Pb) Lead emissions from sandblasting of bridges, overpasses, and water tanks and coal combustion are the most significant sources of lead contamination in the state. There have been no exceedances of the lead ambient air quality standard in recent years. The Lead (Pb) ambient air concentrations continue to decrease due to a steady decrease in the use of leaded fuels which were the most significant source of airborne lead in North Carolina. There are no major point sources of lead in North Carolina.

Acid Rain is formed when nitrogen oxides and sulfur dioxide change into nitrate and sulfate ions. These ions reach the upper atmosphere and absorb moisture to form acid precipitation. Acid rain data is available for 9 sites in and around North Carolina for 1990. Monitoring for acid rain will help to identify trends and reflect efforts made to reduce emissions from mobile and industrial sources.

I. AMBIENT AIR QUALITY STANDARDS

Ambient air quality is determined by comparing measured ambient pollutant concentrations to the corresponding standard. The "ambient air" is defined by the Environmental Protection Agency (EPA) as "that portion of the atmosphere, external to buildings, to which the general public has access." The ambient air quality standards are classified as primary standards, secondary standards, or both. The primary standards were established to allow an adequate margin of safety for protection of public health. Secondary standards were established with an adequate margin of safety to protect the public welfare from adverse effects associated with pollutants in the ambient air. In protecting public welfare, air pollution effects on the following are considered: soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, climate, property, transportation, economy, personal comfort, and well-being. The scientific criteria upon which the standards are based are periodically reviewed by EPA and the standards are re-established or changed based upon the findings. An "exceedance" of the ambient air quality standard is defined as a measurement that is greater than the standard for a specifically averaged time.

The national primary and secondary standards and the North Carolina ambient air quality standards are summarized in Table I. Brief descriptions of air pollutants for which ambient air quality standards exist are included in Section III of this report.

TABLE I: Summary Of National And N.C. Ambient Air Quality Standards

	TIME OF AVG.	NAT. PRIM. STD	NAT. SEC. STD	N.C. STD
TSP [a]	Ann. Geo. Mean	75$\mu g/m^3$[a]	None	75$\mu g/m^3$
	24 Hour[b]	260$\mu g/m^3$[a]	150$\mu g/m^3$[a]	150$\mu g/m^3$
PM-10	Ann. Arith. Mean[a]	50$\mu g/m^3$[a]	Same as prim.[a]	50$\mu g/m^3$[a]
	24 Hour [a,c]	150$\mu g/m^3$[a]	Same as prim.[a]	150$\mu g/m^3$[a]
SO_2	Ann. Arith. Mean	80$\mu g/m^3$	None	80$\mu g/m^3$
	24 Hour [b]	365$\mu g/m^3$	None	365$\mu g/m^3$
	3 Hour [b]	None	1300$\mu g/m^3$	1300$\mu g/m^3$
NO_2	Ann. Arith. Mean	.053ppm	Same as prim.	.053ppm
CO	8 Hour [b]	9ppm	None	9ppm
	1 Hour [b]	35ppm	None	35ppm
O_3	1 Hour [c]	0.12ppm	Same as prim.	0.12ppm
Pb	Quarterly Arith. Mean [b]	1.5$\mu g/m^3$	Same as prim.	1.5$\mu g/m^3$

a. The National Total Suspended Particulate (TSP) standards were replaced by National Particulate Matter-10 micrometer, aerodynamic diameter, (PM-10) standards on 7-31-87 by EPA. The North Carolina PM-10 standard is effective July 1, 1988.
b. Not to be exceeded more than once per year.
c. Not to be exceeded on more than an average of one day per year. (Four days with an exceedance at a site in three years or less is a violation.)

$\mu g/m^3$ - micrograms per cubic meter of air
microgram - one millionth of a gram, where 454 grams = 1 pound
ppm - parts per million

II. 1990 AMBIENT AIR QUALITY DATA

There are many factors that affect the quality of air in an area. Air quality is a function of meteorological conditions, location and amount of pollutants emitted from pollution sources. The speed and direction of air movement determine whether pollutant emissions cause exceedances of the ambient air quality standards and where those exceedances occur. Other meteorological factors that affect pollutant concentrations include atmospheric stability, precipitation, solar radiation and temperature.

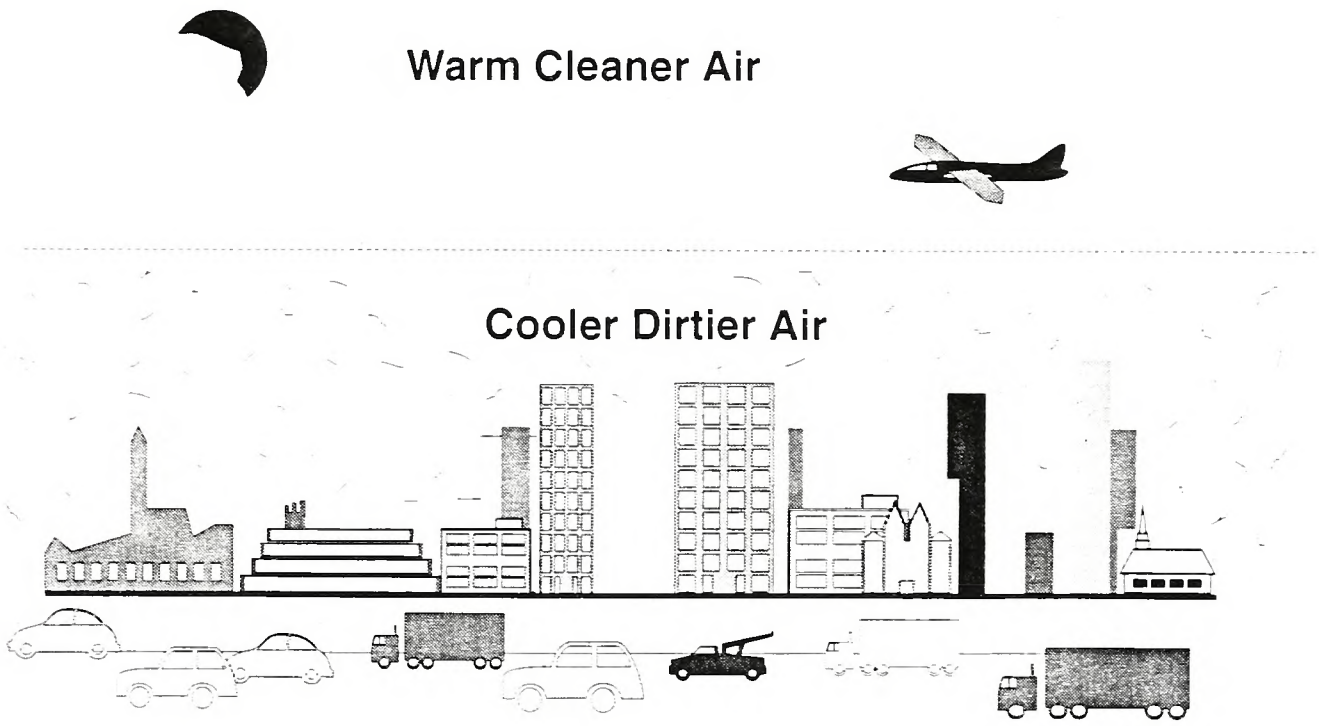
Geographic factors that affect concentrations include variables such as whether an area is urban or rural, has mountains, valleys or plains. Economic factors that are important include concentration of industries, boom or recession, weekday or weekend. All of these variations may affect air pollution patterns either on a short-term or long-term basis.

Air quality may also be influenced by an "exceptional event." Such an event may be natural or man-made and may cause the data to be biased. Most high data and all exceedances are examined to detect "exceptional events" and to avoid misuse or misinterpretation of the data. All valid data, whether "exceptional events" or not, are included in these data summaries. Data known to have been affected by exceptional events are not included in the figures and graphs, but are included in tables. A listing of typical exceptional events is given in Appendix B.

Ambient Data

State and local agencies operated 132 air pollution monitors in North Carolina in 1990.* A summary of the valid 1990 ambient air quality data collected is presented following a discussion of the data. To save operating costs, the monitor operations at some sites are suspended for two years and operated on the third year. For those monitors not operating during 1990, data for the most recent sampling year (1988 or 1989) are included in this report.

*A listing of these agencies is provided in Appendix A.



II. A. Particulate Matter Total Suspended Particulate

Total Suspended Particulate (TSP) matter is collected on filters using a "high volume" sampler method. The "high volume" motor is set at approximately 40 feet^3/minute. Gravimetric analysis (EPA Reference Method) is performed by weighing the exposed filters to the nearest milligram on a calibrated analytical balance.

Since the adoption of the National PM-10 standards, EPA no longer requires monitoring of TSP. However, the TSP standards were retained by the state and 65 network sites measured TSP in 1990. A total of 3,465 TSP samples were collected. A summary of these data appears in Table II. Two of the 3,465 samples exceeded the state ambient air quality 24-hour standard. This compares to four samples which exceeded the State 24-hour standard in 1989. Both of the samples which exceeded the standard occurred at the Corporation Parkway (37-067-0023) site in Forsyth County during I-40 construction. This monitor location was selected for this reason. Neither exceedence was caused by an exceptional event.

The second highest 24-hour measurement, not affected by an exceptional event, is compared to the state ambient air quality standard to determine attainment status. Figure 1 presents thes second highest values with the data affected by exceptional even excluded for each county monitored. Forsyth County (37-067-002 site measured two nonbiased valid exceedances; therefore, thes sites violated the 24-hour TSP ambient air quality standard. **A other areas of the state are considered to be attaining the sta ambient air quality standards for total suspended particulat**

The annual geometric mean is also compared to the annual ambie air quality standard to determine attainment status. There are n sites violating the state annual TSP ambient air quality standar Figure 2 presents the highest annual geometric mean for eac county monitored.

A description of the sources and health effects of TSP are provide in Section III.A.

TABLE II: Total Suspended Particulates [A] In Micrograms Per Cubic Meter (mg/m^3)

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-Hour Maximum 1ST	2ND	3RD	Arith MEAN	Geo MEAN	Geo STD	#>260	GM>75	#>150
37-001-0001	Alamance	Burlington	1136 E. Webb Ave.	55	85	75	74	46		1.5			
37-003-0003	Alexander	Taylorsville	SR 1107 & 1117	61	116	61	59	39	36	1.6			
37-013-1003	Beaufort	Washington	400 E. Third St.	61	75	75	75	44	41	1.5			
37-021-0003	Buncombe	Asheville	Health & Social Service Bldg.	58	81	59	56	37	34	1.5			
37-021-0025	Buncombe	Regional Airport	I-26 S.	56	106	72	65	37	32	1.7			
37-021-0026	Buncombe	Grovestone	WNC Shopping Center	60	74	66	64	39	36	1.6			
37-021-0027	Buncombe	Candler	US 19-23	58	86	77	65	43	40	1.5			
37-025-0004	Cabarrus	Kannopolis	Floyd St.	57	90	86	78	51	48	1.4			
37-027-0003	Caldwell	Lenoir	HWY 321 N.	57	80	68	66	42	39	1.5			
37-031-0003	Carteret	Morehead City	Anandell & 4th Streets	55	97	95	88	54	50	1.5			
37-035-0004	Catawba	Hickory	1650 First St.	52	140	101	98	62	58	1.5			
37-047-0001	Columbus	Acme Delco	SR 1878	61	116	83	81	42	38	1.5			
37-051-0004	Cumberland	Fayetteville	Fire Sta. 5, 3296 Village Dr.	58	107	100	91	54	50	1.5			
37-057-0002	Davidson	Lexington	S. Salisbury St.	57	99	85	81	54	51	1.4			
37-057-1001	Davidson	Thomasville	City Hall, 7 W. Guilford St.	61	96	91	87	52	49	1.5			
37-063-0001	Durham	Durham	Health Dept., 300 E. Main St.	31	67	65	64	48	46	1.4			
37-065-0002	Edgecombe	Rocky Mount	Legett Rd., Waste Treatment	59	145	102	88	52	48	1.5			
37-067-0001	Forsyth	Walkertown	Grubbs Road	46	79	65	64	40	37	1.5			
37-067-0013	Forsyth	Winston-Salem	720 Ridge Avenue	59	95	82	80	50	47	1.5			
37-067-0020	Forsyth	Winston-Salem	Silas Creek Pkwy at Hawthorn	60	109	92	86	50	45	1.6			
37-067-0021	Forsyth	Winston-Salem	Sixth & Broad St., Friends Ch.	61	74	73	70	42	39	1.5			
37-067-0023	Forsyth	Winston-Salem	1401 corporation Parkway	59	203	166	117	75	68	1.6			2
37-067-1001	Forsyth	Kernersville	Bodenheimer St.	7	69	60	58	47	43	1.6			
37-071-0014	Gaston	Gastonia	Rankin Lake Rd.	50	68	63	62	39	36	1.5			
37-081-0004	Guilford	High Point	650 Francis St.	61	76	68	66	40	37	1.6			
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade St.	61	70	69	64	41	38	1.5			
37-081-0010	Guilford	Greensboro	1305 Merritt Dr.	57	94	87	76	47	42	1.6			
37-081-0012	Guilford	Greensboro	Western Guilford High School	57	74	71	70	40	35	1.6			
37-081-1003	Guilford	High Point	National Gaurd Armory	59	95	94	91	51	46	1.6			
37-081-1005	Guilford	High Point	E. Green & S. Centennial St.	60	122	95	94	55	51	1.5			
37-083-0002	Halifax	Roanoke Rapids	Fifth & Carolina Streets	60	78	75	75	47	44	1.5			
37-085-0001	Harnett	Dunn	Municipal Building	59	108	93	88	54	50	1.5			
37-087-0002	Haywood	Canton	Roof, Canton Fire Dept.	56	112	101	86	55	51	1.5			
37-087-0006	Haywood	Hazelwood	Fire Station Brown Ave.	54	96	92	92	50	47	1.5			
37-089-1005	Henderson	Hendersonville	US 25 & US 64	61	70	68	65	44	41	1.5			
37-107-0003	Lenoir	Kinston	1700 Market St.	58	98	84	79	41	38	1.5			
37-109-0002	Lincoln	Lincolnton	Jail	55	74	74	72	49	46	1.4			
37-111-0002	McDowell	Marion	Courthouse	39	89	84	83	54	51	1.5			
37-119-0001	Mecklenburg	Charlotte	600 E. Trade St.	59	83	80	79	49	45	1.5			
37-119-0002	Mecklenburg	Charlotte	Community Hospital	24	83	81	73	49	45	1.5			
37-119-0003	Mecklenburg	Charlotte	Fire Sta #11, 620 Moretz St.	58	100	89	89	55	50	1.6			
37-119-0010	Mecklenburg	Charlotte	Fire Sta#10, 136 Remount Rd.	58	83	77	74	46	43	1.5			
37-119-0011	Mecklenburg	Charlotte	Co. Hlt. Dept. Roof, 1200 Blythe	44	85	76	69	43	40	1.5			

TABLE II: Total Suspended Particulates [A] In Micrograms Per Cubic Meter (mg/m^3)

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-Hour Maximum 1ST	2ND	3RD	Arith MEAN	Geo MEAN	Geo STD	#>260	GM>75	#>150
37-119-0026	Mecklenburg	Charlotte	Woodlawn, Nations Ford Rd.	36	74	70	68	46	44	1.4			
37-119-0028	Mecklenburg	Charlotte	1501 N. I-85	43	77	74	68	46	43	1.5			
37-119-0901	Mecklenburg	Charlotte	7400 Tuckasegee	41	96	69	63	42	39	1.5			
37-119-1001	Mecklenburg	Davidson	Filter Plant	54	71	70	61	37	33	1.6			
37-119-1003	Mecklenburg	Huntersville	Holbrook Road	42	70	66	64	41	38	1.5			
37-119-1005	Mecklenburg	Charlotte	400 Arrowood Blvd.	56	122	121	118	61	54	1.7			
37-119-1006	Mecklenburg	Charlotte	Neck Road, Duke Power #2	40	91	59	59	38	35	1.5			
37-119-2001	Mecklenburg	Mint Hill	Telephone Substation	43	81	76	74	41	38	1.5			
37-121-0001	Mitchell	Spruce Pine	City Hall, Summit St.	58	126	88	82	48	44	1.5			
37-129-0005	New Hanover	Wilmington	Ninth & Orange Streets	57	142	81	79	46	43	1.5			
37-133-0004	Onslow	Jacksonville	2553 Onslow Drive	38	99	81	67	45	43	1.4			
37-139-0001	Pasquotank	Elizabeth	City Water Plant, N.Wilson St.	61	96	75	69	40	37	1.5			
37-147-0003	Pitt	Greenville	1500 Beatty St.	56	96	93	81	52	48	1.5			
37-151-0003	Randolph	Asheboro	1462 Winslour St.	57	70	69	65	39	37	1.5			
37-155-0003	Robeson	Lumberton	South Water St.	60	89	86	78	46	42	1.5			
37-159-1005	Rowan	Salisbury	Church St.	56	87	82	79	50	46	1.5			
37-165-0003	Scotland	Laurinburg	Waste Treatment Plant	60	93	78	74	44	41	1.5			
37-175-0002	Transylvania	Brevard	Hwy 64	51	62	57	55	38	36	1.4			
37-183-0003	Wake	Raleigh	Fire Station #9, Six Forks Rd.	61	72	65	65	41	39	1.5			
37-187-0002	Washington	Plymouth	Old Acre Rd.	57	82	68	67	39	37	1.4			
37-191-0004	Wayne	Goldsboro	Hwy 70 West, Patrol Station	39	104	96	84	54	50	1.5			
37-195-0002	Wilson	Wilson	Kenan St. & Tarboro St.	60	95	77	76	47	43	1.5			

(A) This Table includes all valid TSP Data, including those affected by exceptional events.
(B) A more detailed listing of exceedances is given in Table III.

Table III: 1990 TSP Exceedances

Site Number	Site Name	Date	TSP Value (μ/m^3)	Exceptional Event(s)
37-067-0023	Forsyth Co. Corporation Parkway	8-3-90	203	None
37-067-0023	Forsyth Co. Corporation Parkway	11-1-90	166	None

II. B. Particulate Matter - PM-10

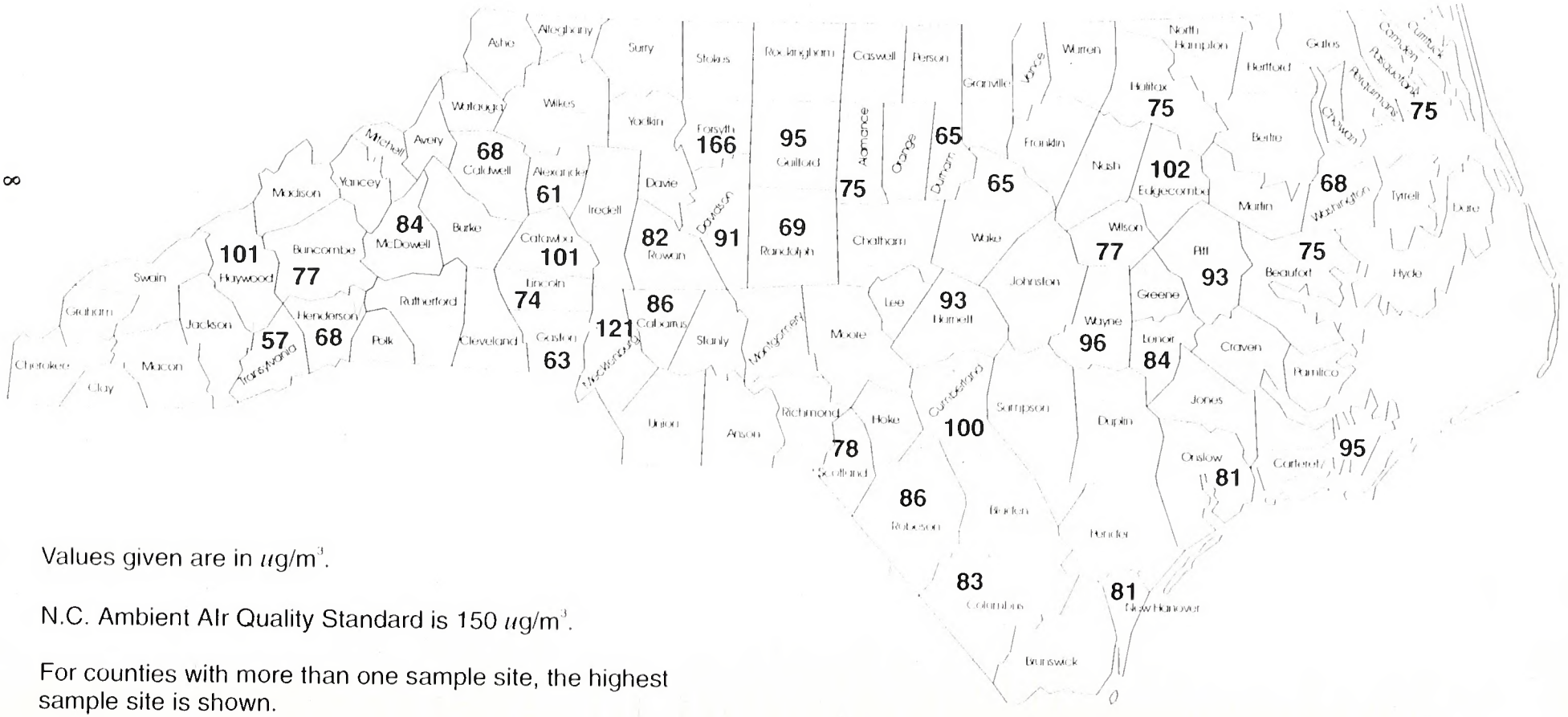
Particulate Matter-10 micrometers or less (PM-10) is collected using high volume samplers and size selective inlets and is analyzed using a gravimetric analysis procedure (EPA Reference Method) by the state and four local program agencies. A description of PM-10 sources and health effects is included in Section III-A. There were 20 sample sites measuring PM-10 during all or part of 1990. The PM-10 monitors are installed in areas expected to experience PM-10 problems as indicated by complaints and TSP data. Most of these monitors are in major cities.

The special study PM-10 monitoring at Shallotte in Brunswick County has not shown any excessive readings. With the reduction of open burning in this area, this project will be discontinued at the end of 1990.

A total of 873 PM-10 samples were collected. A summary of these data appears in Table IV. **There were no PM-10 values exceeding the national ambient air quality 24-hour or annual standards.** Figure 3 presents the second highest 24-hour values for each county monitored. The highest 24-hour value is 113 $\mu g/m^3$ which is 75 percent of the ambient air quality standard of 150 $\mu g/m^3$. Figure 4 presents the annual arithmetic mean for each county monitored. The highest annual arithmetic mean is 37 $\mu g/m^3$ or 74 percent of the ambient air quality annual standard of 50 $\mu g/m^3$.

PM-10 to TSP ratios are useful in estimating PM-10 concentrations from existing TSP data. Based on the 1990 annual arithmetic means, the PM-10 to TSP ratios vary from 46 to 72 with an average ratio of 63 ...meaning that generally 63 percent of the TSP collected is PM-10. At the highest of these ratios, sites having TSP annual arithmetic means equal to or above 79 $\mu g/m^3$ have a reasonable likelihood of exceeding the PM-10 annual standard. In 1990, there were no TSP sites with annual arithmetic means above 79 $\mu g/m^3$. The potential for PM-10 exceedances exists at some TSP sites. On July 31, 1987, the EPA replaced the TSP air quality standards with standards based on particulate matter with an aerodynamic diameter less than 10 micrometers (PM-10). PM-10 standards were developed due to the health effects associated with small, breathable particles.

Figure 1
Total Suspended Particulate
1990 Second Highest 24-Hour Average

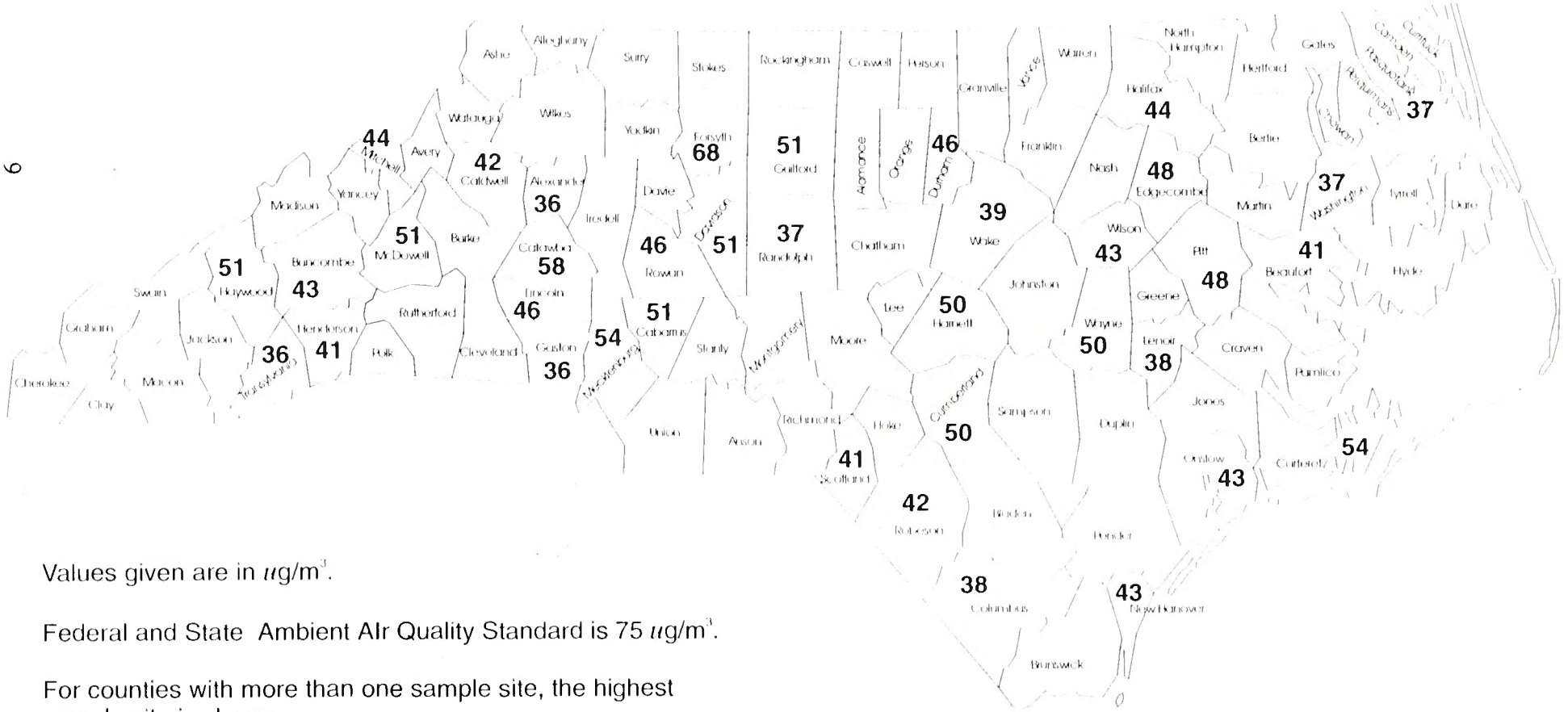


Values given are in $\mu g/m^3$.

N.C. Ambient Air Quality Standard is 150 $\mu g/m^3$.

For counties with more than one sample site, the highest sample site is shown.

Figure 2
Total Suspended Particulate
1990 Maximum Annual Geometric Means



Values given are in $\mu g/m^3$.

Federal and State Ambient Air Quality Standard is 75 $\mu g/m^3$.

For counties with more than one sample site, the highest sample site is shown.

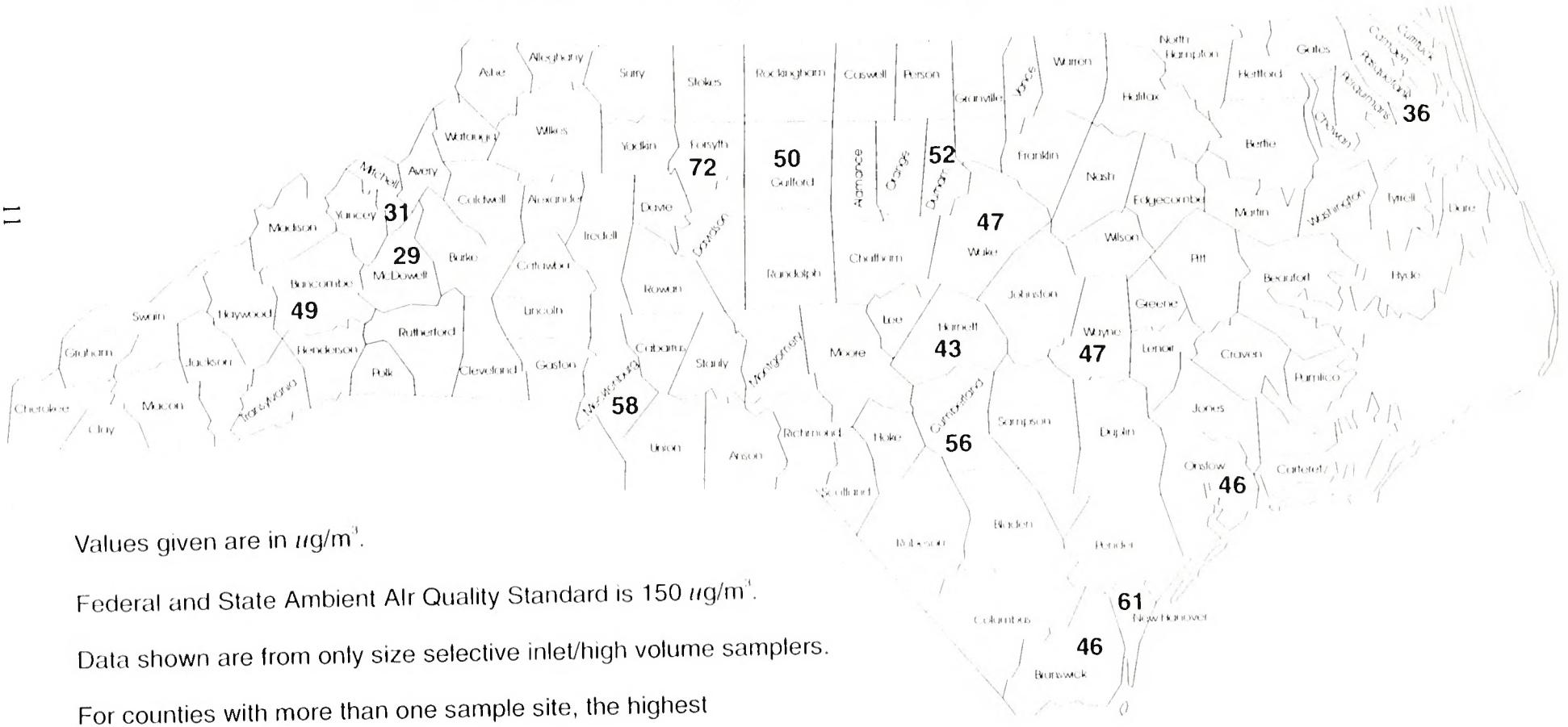
11/1/95

Table IV: PM-10 In Micrograms Per Cubic Meter ($\mu g/m^3$) for 1990*

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24 Hour Maximum 1ST	2ND	3RD	4TH	Arith MEAN
37-019-0004	Brunswick	Shallotte	State Road 1163	67	49	46	44	36	22
37-021-0003	Buncombe	Asheville	Health & Social Services	57	53	49	47	47	25
37-051-0004	Cumberland	Fayetteville	Fire Sta #5, 3296 Village Dr.	57	59	56	55	52	31
37-063-0001	Durham	Durham	Health Dept., 300 E. Main St.	52	72	52	51	49	30
37-067-0009	Forsyth	Winston-Salem	Indiana Ave. & Akron Dr.	58	59	58	53	52	31
37-067-0013	Forsyth	Winston-Salem	720 Ridge Ave.	59	65	60	59	58	33
37-067-0020	Forsyth	Winston-Salem	Silas Creek Pkwy at Hawthorne	18	46	46	44	41	35
37-067-0020	Forsyth	Winston-Salem	Silas Creek Pkwy at Hawthorne	32	50	46	43	41	28
37-067-0023	Forsyth	Winston-Salem	1401 Corporation Parkway	47	77	72	59	58	35
37-067-1001	Forsyth	Kernersville	Bodenheimer Street	57	61	58	56	54	32
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade	61	51	50	49	48	29
37-085-0001	Harnett	Dunn	Municipal Building	17	59	43	43	41	34
37-111-0002	McDowell	Marion	Courthouse	16	37	29	29	27	26
37-119-0010	Mecklenburg	Charlotte	Fire Sta #10, 2136 Remount Rd.	59	68	58	50	50	33
37-121-0001	Mitchell	Spruce Pine	City Hall, Summit Street	13	34	31	31	28	22
37-129-0005	New Hanover	Wilmington	Ninth & Orange Streets	61	113	61	54	50	28
37-133-0004	Onslow	Jacksonville	2553 Onslow Dr.	20	56	46	46	46	32
37-139-0001	Pasquotank	Elizabeth City	Water Plant, N. Wilson	18	46	36	36	31	25
37-183-0003	Wake	Raleigh	Fire Sta #9, Six Forks Rd.	61	48	47	47	46	28
37-191-0004	Wayne	Goldsboro	Hwy 70 West, Patrol Station	8	49	47	46	42	37

*There were no exceedances of the 24-hour standard (150 $\mu g/m^3$) or the annual arithmetic mean (50 $\mu g/m^3$) in 1990.

Figure 3
PM-10
1990 Second Highest 24-Hour Values



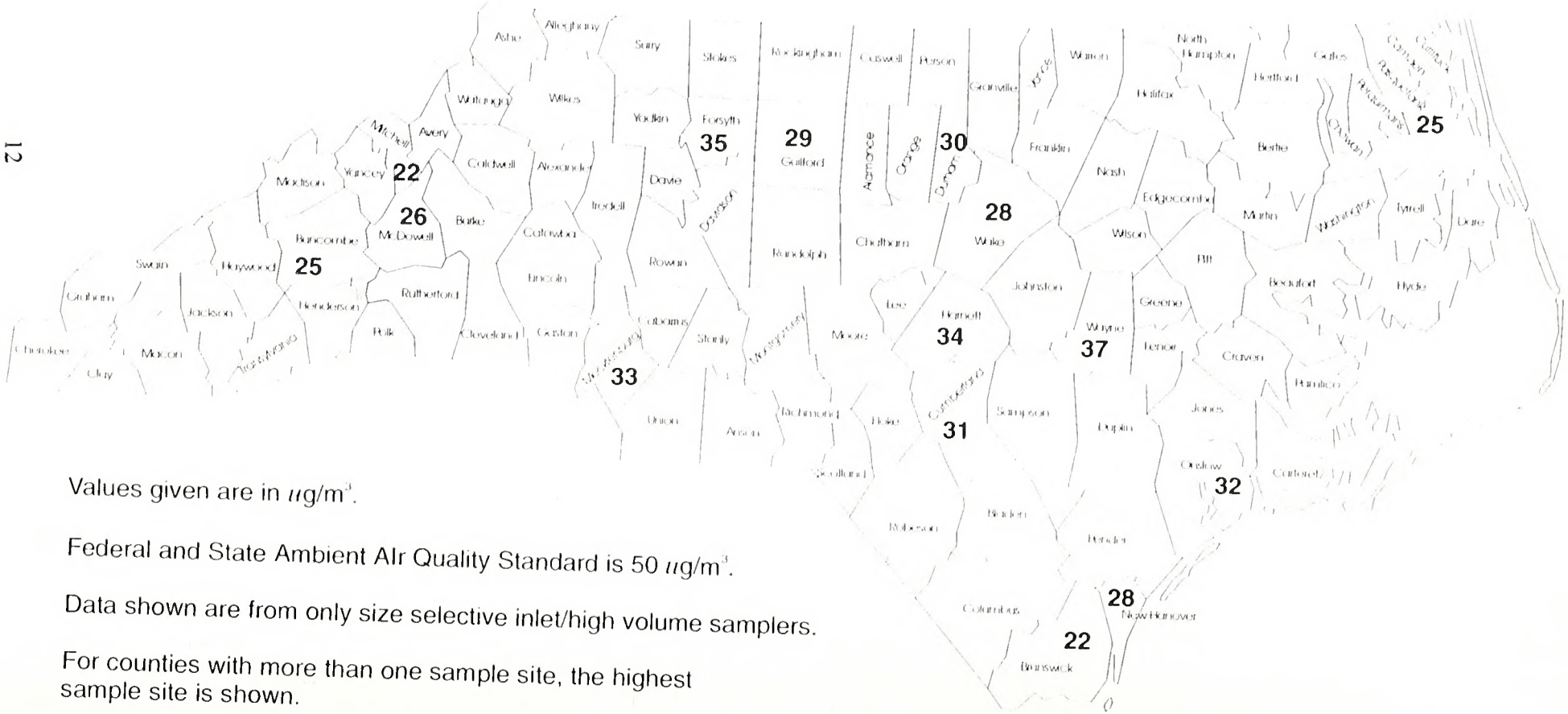
Values given are in $\mu g/m^3$.

Federal and State Ambient Air Quality Standard is 150 $\mu g/m^3$.

Data shown are from only size selective inlet/high volume samplers.

For counties with more than one sample site, the highest sample site is shown.

Figure 4
PM-10
1990 Maximum Annual Arithmetric Means



Values given are in $\mu g/m^3$.

Federal and State Ambient Air Quality Standard is 50 $\mu g/m^3$.

Data shown are from only size selective inlet/high volume samplers.

For counties with more than one sample site, the highest sample site is shown.

II.C. Carbon Monoxide

Carbon monoxide (CO) concentrations are measured using EPA Reference or Equivalent continuous monitors in Raleigh, Durham , Fayetteville and Greensboro by the state and in Forsyth, and Mecklenburg counties by the local program agencies. There were 15 carbon monoxide monitoring sites in six major cities in 1990. A total of 117,798 CO hourly measurements were made. A summary of these data appears in Table V. The second highest 1-hour CO measurement is compared to the 1-hour ambient air quality standard to determine attainment status. A discussion of CO and ozone nonattainment in North Carolina is provided in Appendix C. Figure 5 presents these second highest 1-hour CO measurements. There were no periods exceeding the hourly ambient air quality standard of 35 parts per million.

The second highest 8-hour average CO value is also compared to the ambient air quality standard of nine parts per million to determine attainment status. Figure 6 presents these second highest values for each county monitored. **The 8-hour CO ambient air quality standard was exceeded a total of 2 times in 1990 in the Durham and Raleigh area** as compared to **four** exceedances in 1989 and **five** exceedances in 1988. **In Forsyth County, no CO exceedances were reported in 1990** as compared to two exceedances in 1989 and 1988. **Mecklenburg County reported two exceedances after reporting no CO exceedances in 1989, 1988, 1987 and 1986**. The causes for these CO exceedances - the number of vehicles traveling in nearby streets, the amount of stop and go traffic, and the existence of meteorological conditions which promote poor dispersion of the carbon monoxide.

The daily patterns of highest carbon monoxide measurements further confirm these as the major causes. CO measurements are high during morning and evening "rush" hours with high measurements extending into late evening and early morning hours due to poor atmospheric dispersion which frequently occurs during the night.

The number of CO exceedances in Durham and Raleigh in 1990 is much lower than the 39 exceedances reported in 1986 and the 15 exceedances reported in 1985. The reduction in the number of CO exceedances is attributable to a number of factors in Durham and Raleigh. Due to increased news media interest and reporting of air quality index (refer to Section V), there is greater public awareness of the problem. This increased awareness has contributed to more people keeping their cars in better running condition; therefore, operating cleaner. Older, more polluting vehicles are gradually being replaced with newer and more efficient vehicles. New streets and roads, improved traffic signal coordination that reduces long idling times, and reduced onstreet parking in some areas have improved traffic flow.

Additionally, in Raleigh/Wake County, a motor vehicle Inspection and Maintenance (I/M) program was started in November of 1986. This program has been in full operation since the fall of 1987. Motor vehicle I/M programs will likely be a part of control strategies for all areas reporting CO exceedances in the near future.

Since ambient carbon monoxide exceedances are still occurring, however at a lower frequency than in prior years, changes in the control strategies will be needed for Raleigh and Durham areas. The collection of more CO data will be useful in ensuring the success of these control strategies. Figure 7 identifies the areas not attaining the CO ambient air quality standard in years prior to 1991.

The Fayetteville CO site began operation in late 1988. Fayetteville had no exceedance in 1990 and one in 1989. This monitoring site was installed to provide seasonal CO Air Quality Index (AQI) information and data for the second largest urbanized area in North Carolina. The monitor is located off a heavily traveled city street and near a major four-way intersection. The areas immediately surrounding the monitor are primarily commercial businesses and residential areas. This site was designated as a State and Local Monitoring (SLAMS) site in 1990.

The new Guilford County SLAMS CO monitoring site was added to the network in late 1989. The site is located in Greensboro near a major four-way intersection and city park. The purpose of monitoring at this location is to measure the impact of CO in a worst case situation and determine population exposure.

The two 8-hour CO violations reported in Mecklenburg County in 1990 were the first exceedances since 1985. The motor vehicle Inspection and Maintenance program, traffic flow improvements, and the gradual "turn-over" in the motor vehicle fleet to better controlled vehicles are helping to improve the air quality in Mecklenburg County.

The 1990 and historical data demonstrate that in the autumn and winter more frequent and higher CO exceedances occur than during the warmer seasons. There are several reasons for these seasonal variations:

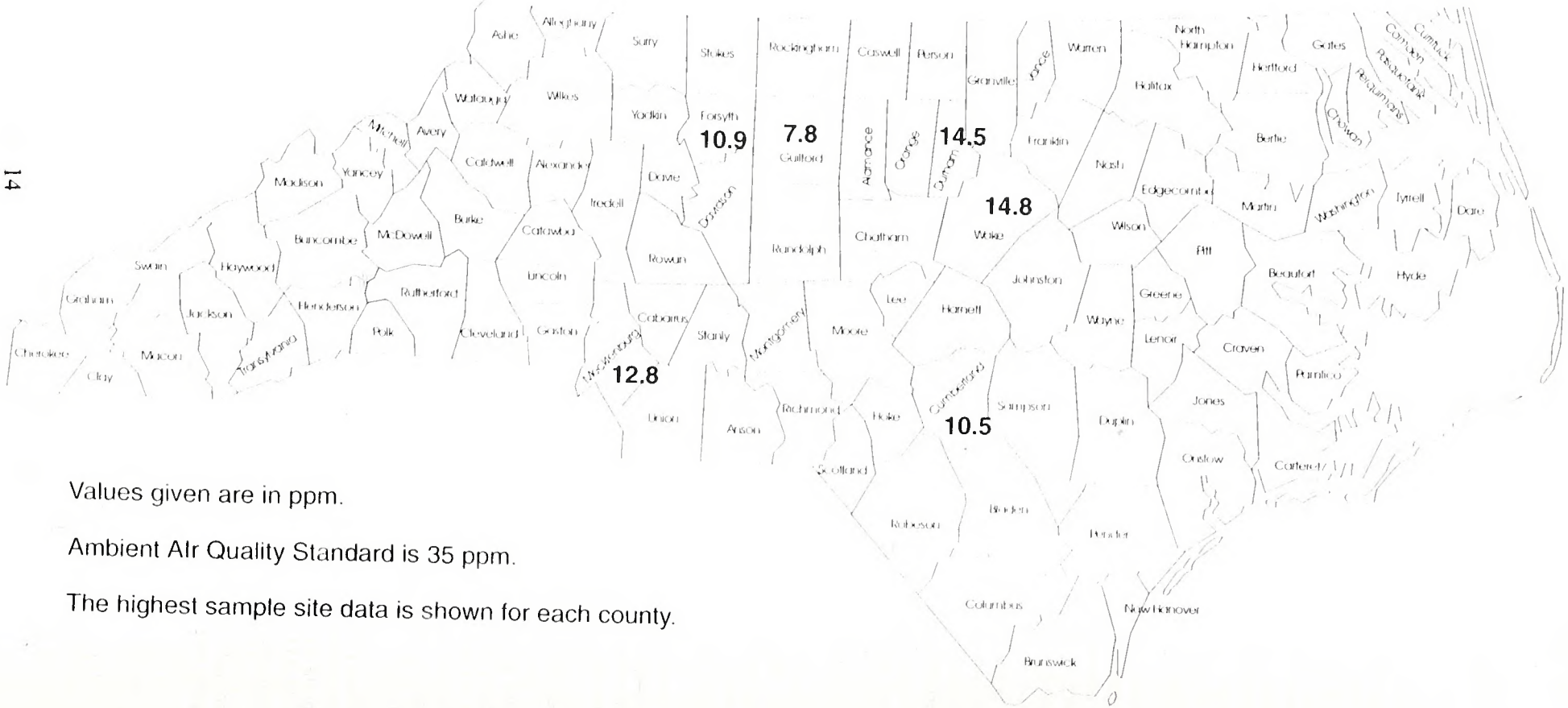
a. In the colder months, North Carolina usually experiences more atmospheric inversions which means a lower atmospheric "mixing height" resulting in poor dispersion of air pollutants. These air pollutants become trapped under a warm layer of air in our atmosphere. We become exposed to higher and higher concentrations until the atmospheric mixing improves. (See diagram on page 4).

b. In colder months, motor vehicles emit more CO due to inefficient combustion during cold starts and warmups. Further, due to seasonal shopping, particularly in November and December, there are more cars operating in the urban areas. It is estimated that more than 80 percent of the CO found in urban areas results from motor vehicle emissions.

c. During colder temperatures, there is more fuel being burned in urban areas for comfort heating which adds to the total CO emitted into the atmosphere.

The monthly frequency of CO exceedances from all sites for 1987, 1988, 1989 and 1990 is shown in Figure 8. Additional information about CO sources and exposure effects is provided in Section III-B Carbon Monoxide.

Figure 5
Carbon Monoxide
1990 Second Highest 1-Hour Average

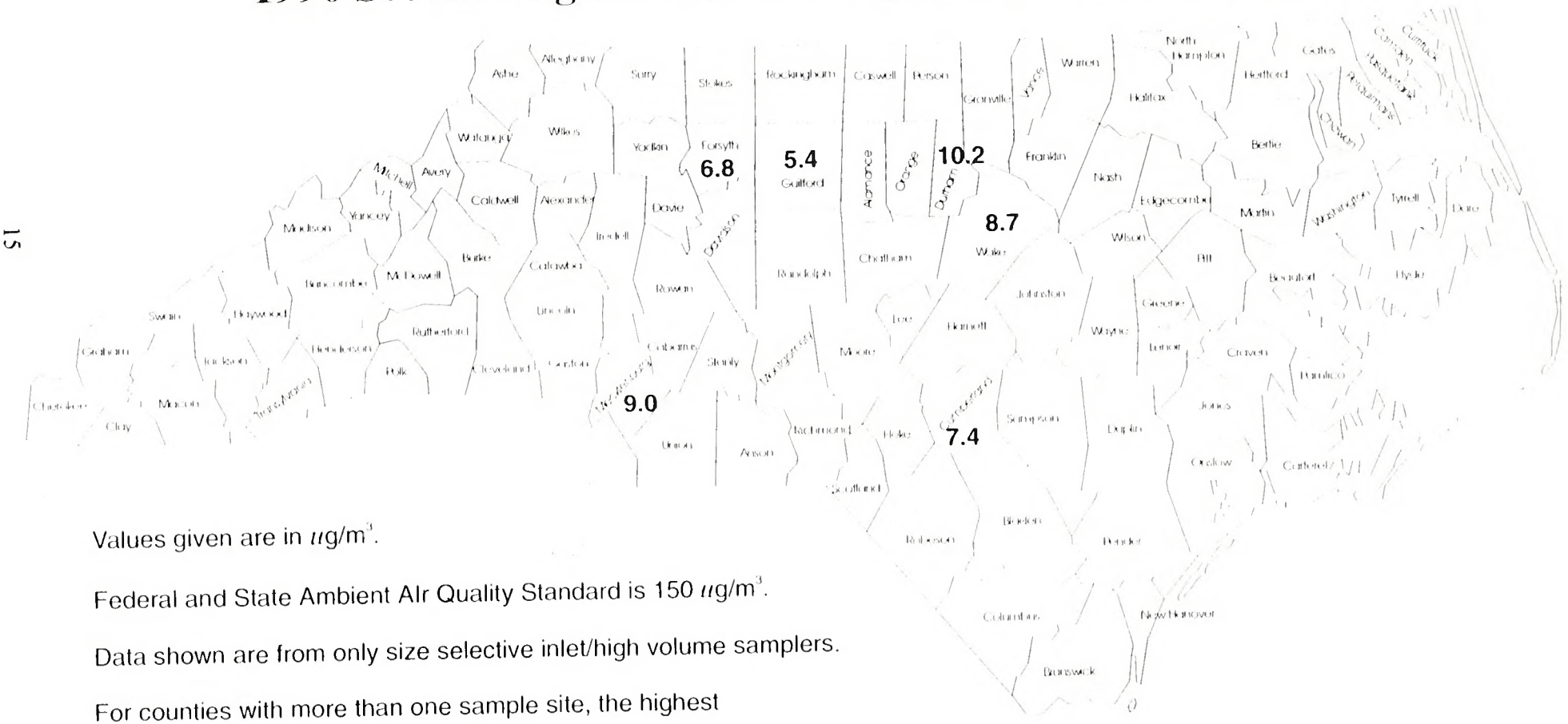


Values given are in ppm.

Ambient Air Quality Standard is 35 ppm.

The highest sample site data is shown for each county.

Figure 6
Carbon Monoxide
1990 Second Highest Non-overlapping 8- Hour Average



Values given are in $\mu g/m^3$.

Federal and State Ambient Air Quality Standard is 150 $\mu g/m^3$.

Data shown are from only size selective inlet/high volume samplers.

For counties with more than one sample site, the highest sample site is shown.

Figure 7
Areas With Excessive Carbon Monoxide

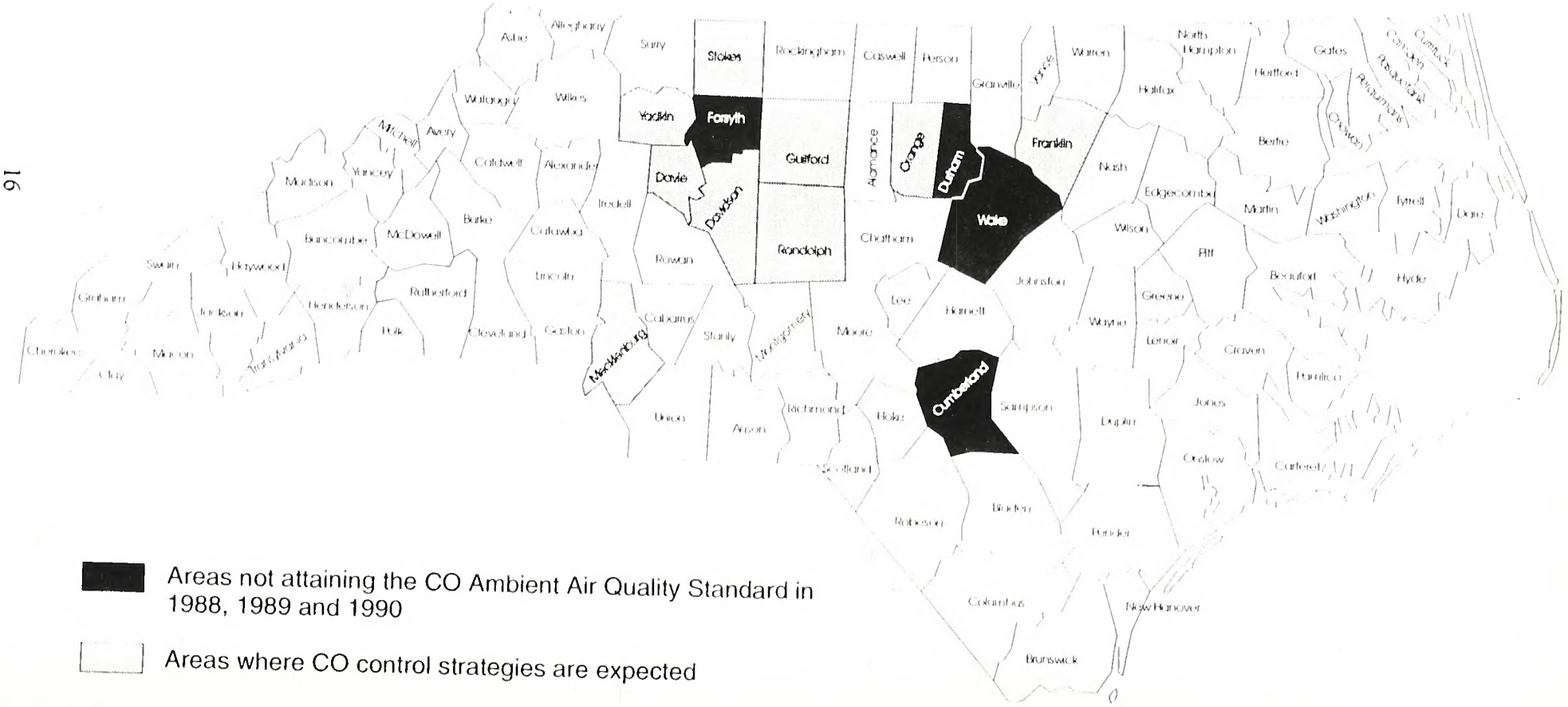


Figure 8
Frequency of Exceedances of the 8-Hour Carbon Monixide Standard

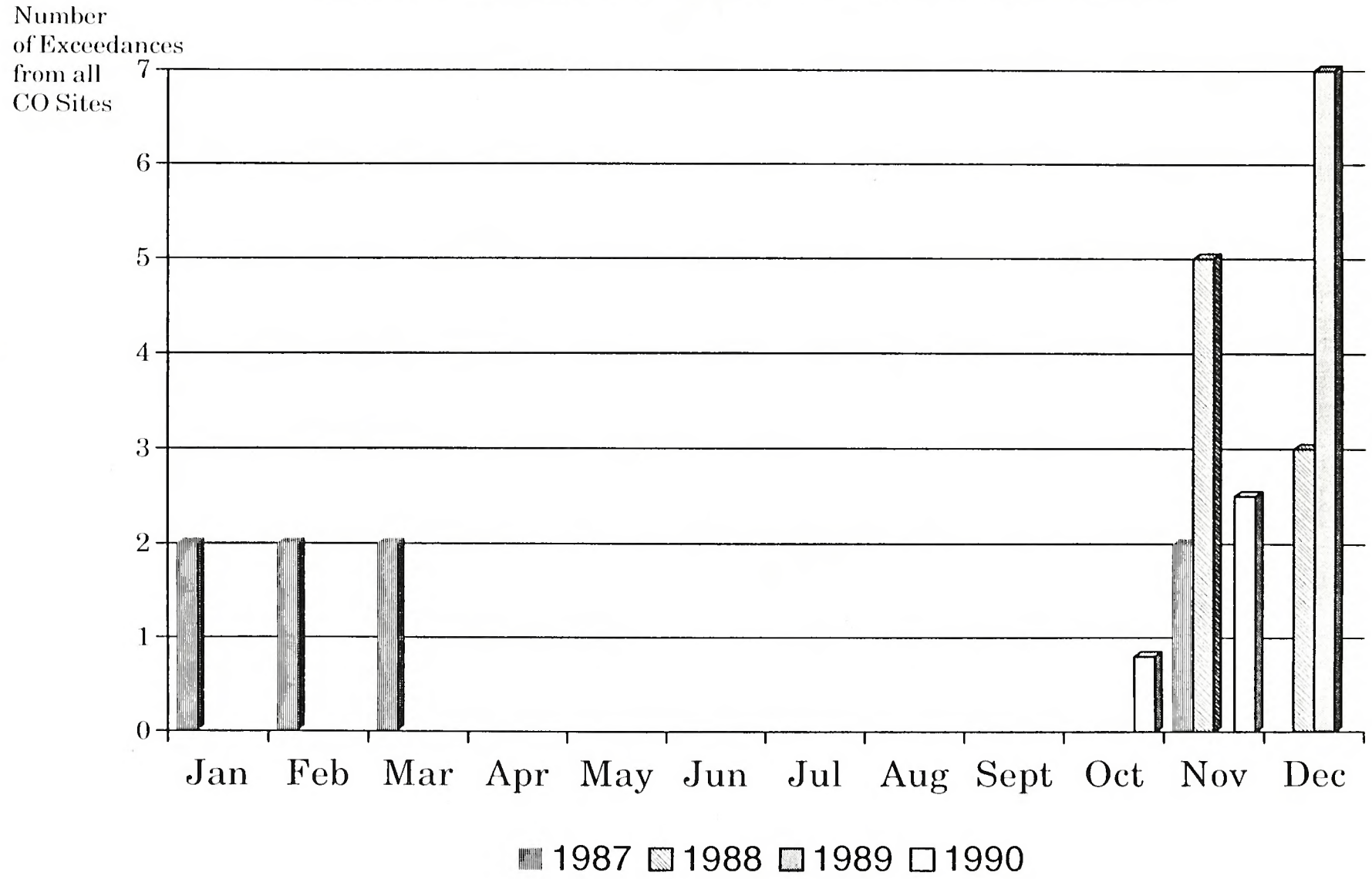


TABLE V: Carbon Monoxide In Parts Per Million (PPM) For 1990

				NUM OBS	1-Hour Max		8-Hour Max		Exceedances 1-Hr	8-Hr
SITE NUMBER	COUNTY	CITY	ADDRESS		1ST	2ND	1ST	2ND	#>35	#>9
37-051-0007	Cumberland	Fayetteville	Cumberland Co. ABC Board	4329	11.2	10.5	7.8	7.4		
37-063-0008	Durham	Durham	302 E. Main Street	8657	14.7	14.5	10.6	10.2		2
37-063-0010	Durham	Durham	City Park on University	8625	9.4	8.4	6.3	5.1		
37-067-0018	Forsyth	Winston-Salem	201 N. Main Street	8702	11.0	10.9	5.8	4.3		
37-067-0019	Forsyth	Winston-Salem	Queen St., Miller Park	8486	6.6	6.5	4.9	4.8		
37-067-0023	Forsyth	Winston-Salem	1401 Corporation Parkway	8679	10.2	9.8	8.7	6.8		
37-081-1011	Guilford	Greensboro	401 West Wendover	8676	9.5	7.8	5.8	5.4		
37-119-0032	Mecklenburg	Charlotte	5137 Central Ave.	8422	13.9	12.8	9.5	8.6		1
37-119-0034	Mecklenburg	Charlotte	Plaza Road and Lakedell	8600	10.2	9.9	6.3	5.6		
37-119-0035	Mecklenburg	Charlotte	1330 Spring Street	8455	9.0	8.9	6.8	6.5		
37-119-0037	Mecklenburg	Charlotte	415 East Woodlawn Road	8642	11.3	11.1	5.8	5.6		
37-119-0038	Mecklenburg	Charlotte	301 N. Tryon Street	8409	12.4	11.4	9.6	9.0		1
37-183-0010	Wake	Raleigh	309 S. Wilmington Street	6186	10.8	10.0	6.3	5.9		
37-183-0011	Wake	Raleigh	420 S. Person Street	8600	15.5	14.8	8.8	8.7		
37-183-0013	Wake	Raleigh	EF Hutton, Hwy 70 West	4330	9.7	9.2	6.5	6.2		

II. D. Ozone

Ozone (O3) is a seasonal pollutant. Ozone is formed in the atmosphere as a result of many chemical reactions which occur in sunlight (photochemical reactions) mostly during the warmer months. For this reason, most of the ozone monitors only operate April through October. The number of days with high ozone readings from 1990 (readings greater than .099 ppm) is shown on a monthly basis in Figure 9. Section III-C provides information about the sources of ozone precursors and health effects of ozone.

Ozone concentrations were measured using EPA Reference or Equivalent continuous monitors by the state and three local program agencies. There were 19 ozone monitoring sites operated in 1990. All of these sites operated only during the ozone season, April through October. **89,010** O_3 hourly measurements were made during 1990. A summary of these data appears in Table VI. Prior years' data from other sites which did not operate in 1990 are also included in Table VI.

For some sites, monitor operations are suspended for two years and operated on the third year. By using this rotational operating strategy, data current within the last three years is available and operating costs are kept to a minimum.

The ozone ambient air quality standard is exceeded when one valid one-hour measurement exceeds .124 parts per million (ppm) at a site and a statistically derived expected number of exceedances exceeds 1. (.124 ppm when rounded to two decimal places is not greater than the standard of .12 ppm; however, .125 ppm, when rounded to two decimal places is .13 and is greater than .12 ppm.) **One measurement at each of three ozone monitoring sites exceeded .124 ppm during 1990.** These 3 exceedances occurred from June through August.

The 1990 ozone season reported only three exeedances as compared to 6 and 15 reported in 1989 and 1987 respectively. Hot and dry meteorological conditons of 1988 likely contributed to the 69 exceedances measured for that year.

Examination of the second highest measurement each year is a way to simply estimate the attainment status of an area. The second highest one hour values are shown in Figure 10 for the most recent season of data for all monitored areas. The areas for which ozone control strategies must be developed are shown in Figure 11.

Mecklenburg County has been designated as an ozone nonattainment area. See Appendix C for a discussion of ozone nonattainment in North Carolina. At one Mecklenburg County ozone monitoring sites, the ambient air quality standard was exceeded one time between June and September as compared to three times in 1989 and 24 times in 1988. More strict hydrocarbon control strategies are being used in Mecklenburg County to reduce the ozone problem.

The control strategies that have been developed as a result of the exceedances measured at the Charlotte area monitors will effect the surrounding counties in the Charlotte-Gastonia-Rock Hill, NC-SC metropolitan statistical area (MSA). These counties are Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union, and York, South Carolina.

For the Durham area, the ambient air quality standard was not violated at the "downwind" ozone site in Butner between June and August for 1990 as compared to three times in 1989. No exceedances were measured in 1990 or 1989 for the Raleigh area at the ozone monitor located in Wake Forest. No Raleigh area exceedances occurred "downwind" between June and August, although high levels of ozone were measured on several occasions.

Ambient air quality standard control strategies are still being developed for the entire metropolitan statistical area represented by the Butner and Wake Forest ozone sites. The five counties affected are Durham, Granville, Orange, Franklin and Wake.

Monitoring data was collected for ozone, nitrogen dioxide (NO_2) and nonmethane organic carbon (NMOC) at a new site (37-183-0014) in northeast Raleigh area in 1989. The NO_2 and NMOC data will be used in a computerized air quality model to determine which pollutant contributes most to the ozone problem and what control strategies should be developed to reduce the presence of that pollutant.

During the summer of 1990, the ozone monitors located in Forsyth, and Guilford counties measured two exceedances of the ambient air standard as compared to no exceedances in 1989 and 23 exceedances in 1988. Control strategies are being developed for the Greensboro-Winston Salem-High Point metropolitan statistical area. Counties in this area are Davidson, Davie, Forsyth, Guilford, Randolph, Stokes and Yadkin. An additional ozone monitoring site was installed and operated beiginning with the 1989 ozone season for the Fayetteville area. The ozone monitors located in the Fayetteville metropolitan statistical area measured no exceedances in 1990 or 1989 as compared to three exceedances in 1988. Control strategies are also being developed for Cumberland County.

An ozone monitoring site was installed and operated beginning with the 1988 ozone season in Camden. The Camden site is located and operated on the northeast coast downwind from the Virginia coast. The purpose of monitoring at this location is to determine the impact of nitrogen oxides and hydrocarbons originating in Virginia on formation of ozone in North Carolina. The Camden site reported no exceedances in 1989 or the 1990 ozone season. Since the Camden site is operated only for this special purpose, it is defined as a special purpose monitor and is not part of the regular monitoring network. This site will be operated on a seasonal basis for the next several years.

A look at ozone data collected from 1988-1990 is included in Appendix D of this report, "Ozone Exceedances in the Last Three Years". In 1985, there were no reported ozone exceedances in the state. From 1985 through 1988, there have been progressively more frequent ozone exceedances with 69 occurring in 1988. More and higher ozone exceedances occurred in more areas in 1988 than any other year on record; however, in 1989 and 1990, ozone exceedances fell below the number of exceedances reported in 1986. Drought conditions contributed to the high number of exceedances in 1987 and 1988. 1990 measured fewer exceedances because of overall wetter conditions. **Ozone remains the criteria pollutant of greatest concern in North Carolina.**

TABLE VI: Most Recent Ozone Data in Parts Per Million (PPM) From all sites For 1990, 1989 and 1988

				NUM OBS	Daily 1-Hour Maximum				VAL ≥ .125	
SITE NUMBER	COUNTY	CITY	ADDRESS		1ST	2ND	3RD	4TH	MEAS	EST
1990 Data										
37-003-0003	Alexander		SR 1107 & 1117	4922	.094	.092	.091	.090		
37-021-0030	Buncombe	Asheville Route	191 S. Brevard	4784	.097	.091	.087	.086		
37-029-0099	Camden	Camden	County Road 1136	4692	.102	.102	.096	.096		
37-051-0001	Cumberland	Eastover	Old US Hwy 301 N	4715	.101	.100	.098	.097		
37-051-0008	Cumberland		1/4 Mi. SR 1857/ US 3	3795	.111	.100	.098	.094		
37-051-1002	Cumberland	Fayetteville	Hope Mills Police Station	4876	.095	.094	.094	.092		
37-065-0099	Edgecombe		Route 2, Box 195	4876	.097	.097	.096	.095		
37-067-0006	Forsyth	Winston-Salem	Goodwill Church Rd.	4784	.113	.104	.102	.101		
37-067-0007	Forsyth	Winston-Salem	5337 Old Rural Hall Rd.	4577	.133	.121	.108	.099	1	1.1
37-067-1008	Forsyth	Winston-Salem	3656 Piedmont Memorial Dr.	4922	.105	.105	.101	.100		
37-077-0001	Granville	Butner	Water Treatment Plant	4577	.105	.103	.096	.095		
37-081-0011	Guilford	Mcleansville	Keely Park	4807	.127	.119	.113	.111	1	1
37-101-0099	Johnston		Highway 301	4830	.099	.096	.095	.094		
37-119-0034	Mecklenburg	Charlotte	Plaza Rd & Lakedell Rd	4600	.118	.110	.110	.107		
37-119-1005	Mecklenburg	Charlotte	400 Arrowood Blvd.	4600	.124	.118	.115	.107		
37-119-1009	Mecklenburg	Charlotte	29 North	4876	.152	.123	.117	.113	1	1
37-129-0002	New Hanover		SR-1002	4163	.102	.093	.092	.092		
37-183-0014	Wake	Raleigh	E. Millbrook Jr. High	4761	.124	.120	.109	.109		
37-183-2001	Wake	Wake Forest	Hwy 98	4853	.100	.098	.096	.092		
1989 Data										
37-027-0003	Caldwell	Lenoir	Hwy 321 N.	4806	.092	.090	.089	.088		
37-037-0098	Chatham	Moncure	Moncure	4593	.095	.092	.089	.089		
37-117-0099	Martin	Farmlife	NC 171	4769	.087	.086	.086	.083		
37-145-0099	Person	Gordonton	US 49 & SR 1102	4634	.089	.088	.087	.084		
37-147-0099	Pitt	Farmville	US 264 Water Tank	4833	.100	.100	.099	.091		
1988 Data										
37-021-0029	Buncombe		Hwy 74	2829	.118	.110	.106	.104		
37-059-0099	Davie		Fork Recreation Center	4761	.153	.151	.145	.139	7	7.2
37-109-0099	Lincoln	Iron Station	Sr 1315 & SR 131	4875	.141	.126	.117	.115	2	2.0
37-155-0099	Robeson	St Pauls	National Guard Armory	4748	.120	.119	.112	.111		

Figure 9
Frequency of High Ozone Values for 1990

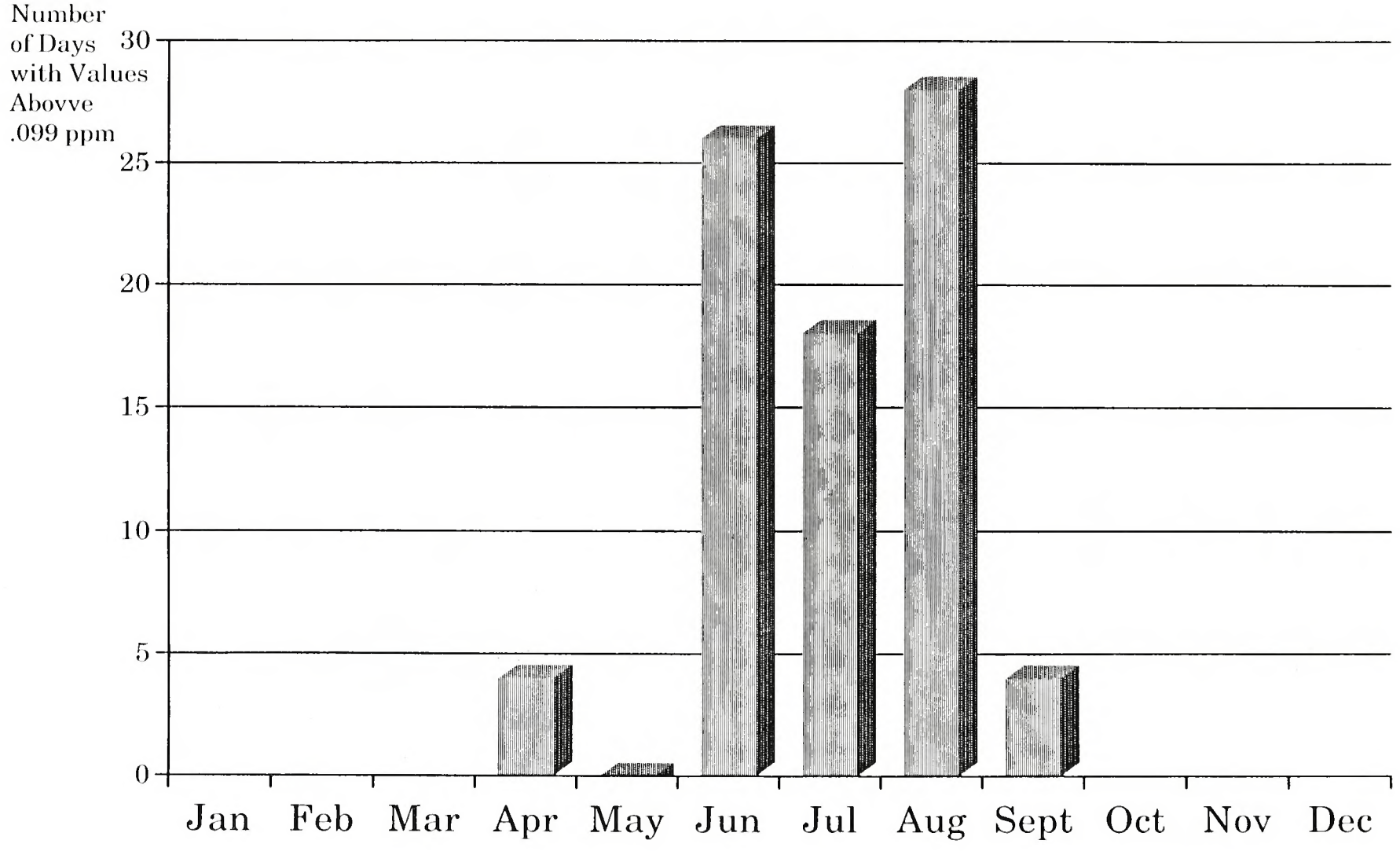
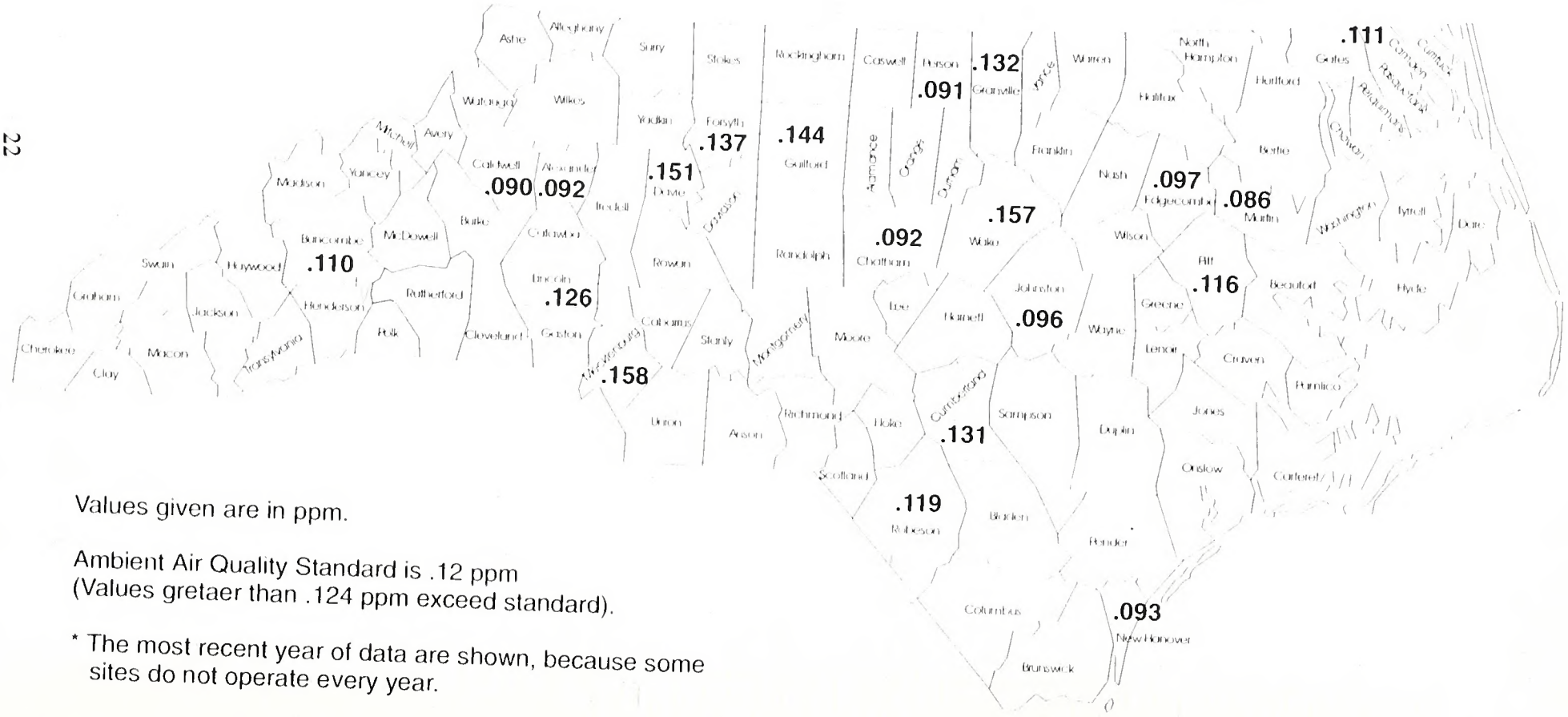


Figure 10
Ozone
1990, 1989, 1988 Second Highest 1-Hour Average*

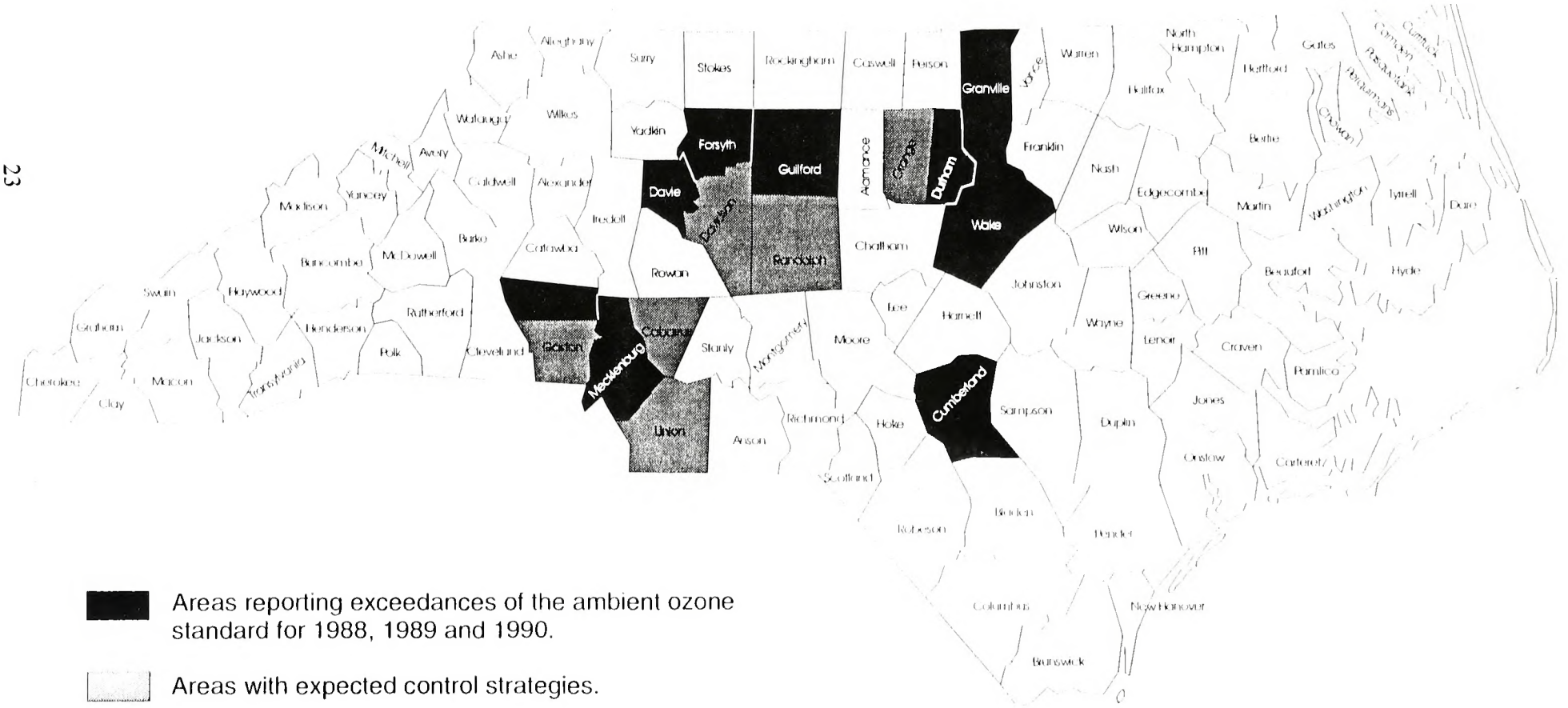


Values given are in ppm.

Ambient Air Quality Standard is .12 ppm
(Values gretaer than .124 ppm exceed standard).

* The most recent year of data are shown, because some sites do not operate every year.

Figure 11
Areas With Excessive Ozone



Areas reporting exceedances of the ambient ozone standard for 1988, 1989 and 1990.

Areas with expected control strategies.

Areas with possible control strategies.

10/16/95

II. E. Sulfur Dioxide

Sulfur dioxide (SO_2) concentrations were measured using EPA Reference or Equivalent continuous monitors by the state and two local program agencies. Ten SO_2 monitoring sites reported a total of 62,633 SO_2 hourly measurements during 1990. A summary of these data appears in Table VII. Prior years' data from other sites which did not operate in 1990 are also included in Table VII. For some sites, monitor operations are suspended for two years and operated on the third year. Using this rotating operating schedule, data current within the last three years are available for use and operating costs are kept to a minimum. Source and health effects information for SO_2 is included in Section III-D.

To determine attainment status with the SO_2 ambient air quality standard, the data are evaluated in three ways: 3-hour averages, 24-hour averages, and an annual arithmetic mean. No twenty-four hour exceedances of the SO_2 ambient air quality standard were reported in 1990. High ambient SO_2 concentrations do not exist over large areas (e.g. county wide), as ozone does. The highest ambient SO_2 concentrations existed for short periods near major SO_2 sources.

At other sites statewide, SO_2 values were well below the state and federal standards for 1990. It appears that the size of an urban area has little effect on the ambient concentrations of SO_2 in North Carolina. Further, there do not appear to be large seasonal variations in average SO_2 concentrations as evident with carbon monoxide or ozone.

Major source characteristics such as type, size, distribution, contr devices, operating conditions, and dispersion situations significant affect the amount of SO_2 present in ambient air. The second highe 3-hour values are shown in Figure 12 for the most recent year of dat for all monitored areas.

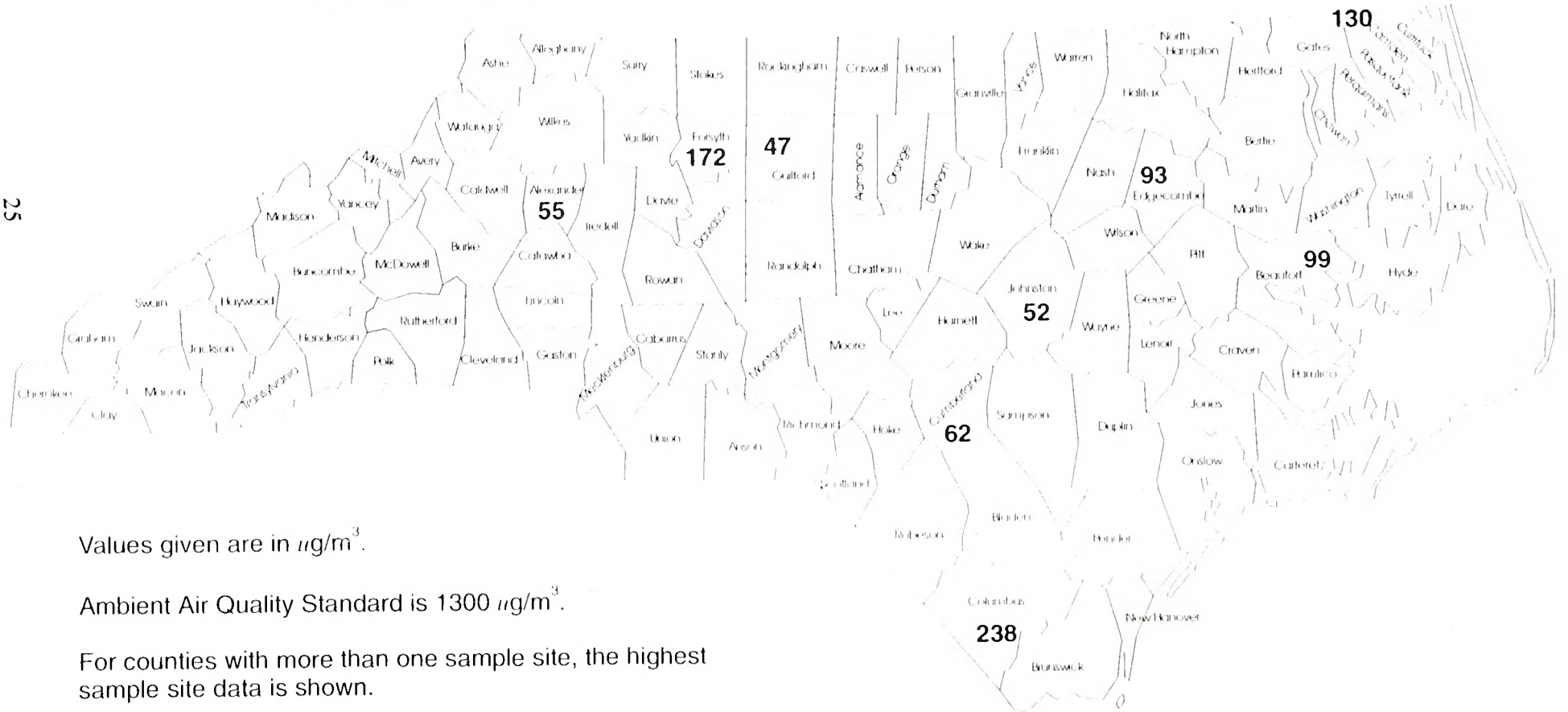
Note: Block Averages - Beginning with 1987, EPA uses 3-hour bloc averages to summarize sulfur dioxide data. Using the bloc averaging technique, eight 3-hour block averages represent eac day. These 3-hour block averages begin at midnight and continu in multiples of three hours. This report and future reports will use th block average method.

Running Averages - Sulfur dioxide maximum 3-hour and 24-hou averages for 1985 and 1986 found in the 1987 and 1988 Nort Carolina Ambient Air Quality Reports are running averages take from EPA's Standards Comparisons Report. The running 3- hou averages are determined hourly. The highest 3-hour values ar selected from these running averages. Persons using these olde reports may need to consider these different averaging method Contact the Air Quality section if block averages are needed.

TABLE VII: Most Recent Sulfur Dioxide Data in Micrograms Per Cubic Meter (ug/m^3) From All Sites For 1990, 1989 and 1988

				NUM OBS	Max 1-Hr		Max 3-Hr		Max 24-Hr		Arith MEAN
SITE NUMBER	COUNTY	CITY	ADDRESS		1ST	2ND	1ST	2ND	1ST	2ND	
1990 Data											
37-003-0003	Alexander		SR 1107 & SR 1117	8169	30	27	65	55	93	73	7
37-013-0003	Beaufort	Aurora	NC Highway 306	8172	47	44	106	99	191	174	8
37-029-0099	Camden	Camden	County Road 1136	1931	56	26	151	130	160	153	11
37-047-0001	Columbus	Acme	Delco Telephone Substation	7864	91	87	379	238	570	470	11
37-051-1002	Cumberland	Fayetteville	Hope Mills Police Station	8300	31	31	66	62	92	88	8
37-065-0099	Edgecombe		Route 2, Box 195	8175	48	25	138	93	156	130	7
37-067-0007	Forsyth	Winston-Salem	5337 Old Rural Hall Rd	3061	60	55	144	127	310	181	19
37-067-0022	Forsyth	Winston-Salem	1300 Block Hattie St.	8468	76	62	222	172	345	269	20
37-081-0010	Guilford	Greensboro	1305 Merritt Dr.	341	24	23	58	47	87	68	15
37-101-0099	Johnston		Highway 301	8152	29	20	53	52	58	56	7
1989 Data											
37-037-0098	Chatham	Moncure	Moncure Plant	7781	632	587	331	329	203	154	18
37-117-0099	Martin	Farmlife	NC 171 & SR 1538	8230	65	61	60	55	35	35	7
37-145-0099	Person	Gordonton	NC 49 & SR 1102	7659	230	211	166	157	72	58	10
1988 Data											
37-059-0099	Davie	Fork	Recreation Center	7980	219	192	149	111	61	52	10
37-097-0002	Iredell	Troutman	SR 2350	2019	462	274	164	163	71	71	20
37-109-0099	Lincoln	Iron Station	SR 1315 & SR 1313	7987	327	278	157	137	62	52	9
37-147-0099	Pitt	Farmville	US 264 Water Tank	8048	136	131	104	101	81	50	9

Figure 12
Sulfur Dioxide
Second Highest 3-Hour Averages for Most Recent Year



Values given are in $\mu g/m^3$.

Ambient Air Quality Standard is 1300 $\mu g/m^3$.

For counties with more than one sample site, the highest sample site data is shown.

II. F. Nitrogen Dioxide

Nitrogen dioxide (NO_2) concentrations were measured using EPA Reference or Equivalent continuous monitors at four new sites in 1990 which includes two sites in Forsyth County. One of the sites in Forsyth county operated for only part of the year. A total of 27,178 NO_2 hourly measurements were reported. A summary of these data appears in Table VIII. Section III-E contains source and health effects information for NO_2.

NO_2 levels measured in North Carolina, based on recent continuous monitor data and a long history of manually collected data, show NO_2 levels are far below federal and state standards. **No exceedances of the NO_2 ambient air quality standard have ever been reported from continuous air monitors operated at state, loca and industrial sites in the state.**

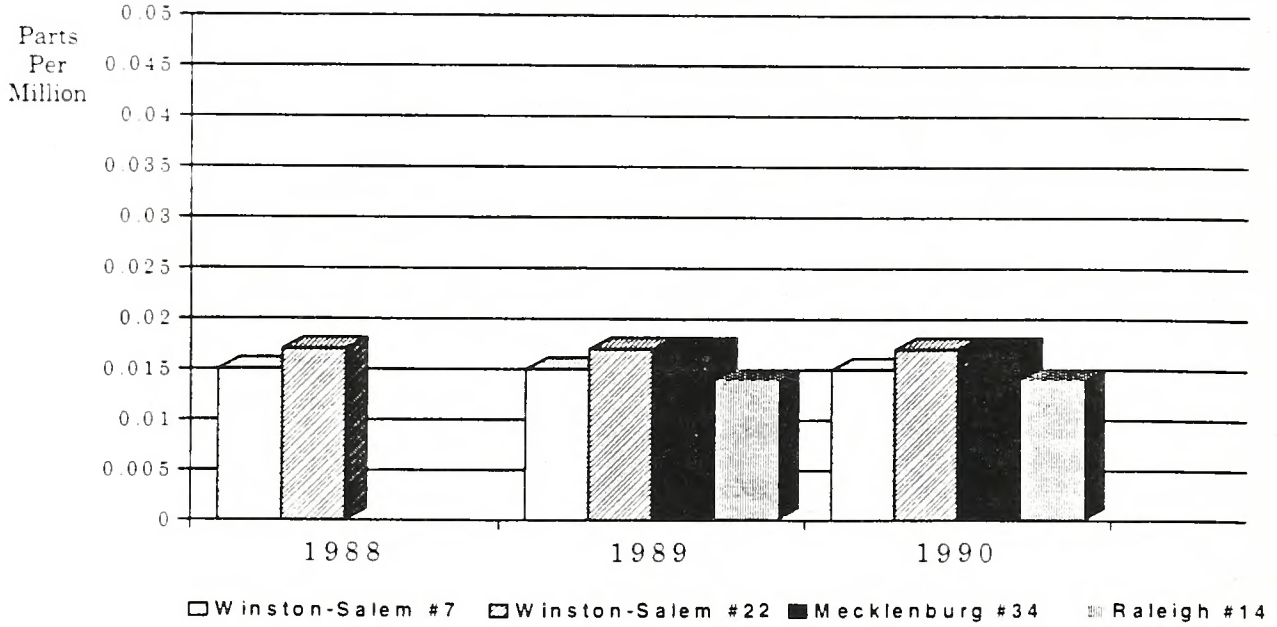
While labor-intensive to operate, NO_x monitoring is important measuring levels of reactive nitrogen oxides. Nitrogen oxides play a important role in the formation of ozone. Therefore, NO_x monitors a currently operated in large metropolitan areas. The NO_x monitorin begun in 1989 will gather data needed to develop an ozone contr strategy in the Raleigh/Durham, Charlotte/Mecklenburg and Winsto Salem/Greensboro areas. The 1990 NO_2 data is compared with th standard in Figure 13 .

TABLE VIII: Nitrogen Dioxide in Parts Per Million (PPM) for 1990

				NUM OBS	Maximum 1 Hour		ARITH MEAN
SITE NUMBER	COUNTY	CITY	ADDRESS		1ST	2ND	
37-067-0007	Forsyth	Winston-Salem	5337 Old Rural Hall Rd	2967*	.075	.070	.015
37-067-0022	Forsyth	Winston-Salem	1300 Block Hattie Ave.	8058	.074	.068	.017
37-119-0034	Mecklenburg	Charlotte	Plaza Rd & Lakedell Rd.	8122	.074	.070	.017
37-183-0014	Wake	Raleigh	E. Millbrook Jr. High	8031	.078	.073	.014

* Monitor became operational mid-year.

Figure 13
1990 Nitrogen Dioxide Comparison to Annual Standard, .053 PPM



II. G. Lead

The state and local program agencies have not performed routine lead (Pb) analysis in North Carolina since 1982. **This ambient air lead monitoring was stopped as a result of the low values measured and as a result of the continuing decrease in the lead concentrations being reported.** The 1982 ambient lead concentrations were approximately one-half of the 1979 levels. Lead sources and health effects are discussed in III.F.

Five sites from the state and local agencies provide particulate filter samples to EPA. EPA performs lead analysis on these filters as part of the National Particulate Analysis program (NPA) formerly the National Filter Analysis Network (NFAN). The 1990 data is included below in Table IX. Lead concentrations in 1990 are approximately one-quarter of the 1982 levels.

The decrease in the ambient air lead concentrations is due to the reduction and elimination of leaded gasoline used in North Carolina. Thus, less lead is emitted from cars burning leaded fuel.

Other sources of lead in the ambient environment are from sandblasting lead paint from water tanks, bridges, and overpasses. Lead in the ambient environment can also come from coal combustion and acid battery manufacturing plants.

TABLE IX: Lead in Micrograms Per Cubic Meter (ug/m^3) for 1990
QUARTERLY ARITH MEANS MEANS

				Quarterly Arithmetic Means				Means >1.5
SITE NUMBER	COUNTY	CITY	ADDRESS	1st	2nd	3rd	4th	
37-063-0001	Durham	Durham	300 E. Main St.	.02	.01	.00	.02	0
37-067-0021	Forsyth	Winston-Salem	Sixth & Broad St.	.01	.01	.00	.01	0
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade St.	.02	.01	.01		0
37-119-0001	Mecklenburg	Charlotte	600 E. Trade St.	.03	.08	.05	.03	0
37-183-0003	Wake	Raleigh	Fire Sta. #9, Six Forks Rd		.00	.01		0

III. DESCRIPTION OF POLLUTANTS

III. A. Particulate Matter

Atmospheric particulate matter is defined as any airborne material, except uncombined water, (water, mist, steam, etc.) which exists in a finely divided form as a liquid or solid at standard temperature and pressure (25° C and 760 mm mercury) and has an aerodynamic diameter of less than 100 micrometers. Currently, the monitoring network is measuring two sizes of particulate matter; total suspended particulate (TSP), and PM-10. Total suspended particulate is any particulate matter measured by the method described in EPA regulation 40CFR50, Appendix B and is generally believed to be particles having an aerodynamic diameter of 45 micrometers or less. A 22-year history of TSP measurements exists in North Carolina.

PM-10 is defined as particulate matter with an aerodynamic diameter of less than or equal to a nominal 10 micrometers as measured by the method described in EPA regulation 40CFR50, Appendix J. PM-10 monitoring was conducted in North Carolina during 1989. More PM-10 monitoring is being planned in 1990 and 1991. On July 31, 1987, the Environmental Protection Agency adopted new ambient air quality standards for PM-10 which replace the national TSP ambient air quality standards. The state TSP ambient air quality standard has been retained. The state adopted the new PM-10 standard effective July 1, 1988.

Particulate Sources

Particulates are emitted by many of man's activities, such as fuel used in combustion, motor vehicle operation and movement, industrial processes, grass mowing, agricultural tilling and open burning. Natural sources include wind-blown dust, forest fires, volcanic eruptions and vegetation which releases pollen.

Particles that are emitted directly from a source may be either fine or coarse, but particles which are formed in the atmosphere will usually be fine. Generally, coarse particles (2.5 - 60 micrometers) have very slow settling velocities and are characterized as suspended particulate matter. Fine particles (less than 2.5 micrometers) typically originate by condensation of materials produced during combustion or atmospheric transformation.

Particulate Effects

Health effects of particulate matter include: effects on the breathing system, aggravation of existing lung and heart disease, effects on lung clearance, changes in form and structure of organisms and development of cancer. The individuals most sensitive to the effects of particulate matter include: individuals with chronic obstructive lung or heart disease, individuals with flu, asthmatics, the elderly, children and mouth breathers. Health effects from inhaled particles are influenced by the depth of penetration of the particles into the respiratory system, the amount of particles deposited in the respiratory system, and by the biological reaction to the deposited particles.

The risks of adverse health effects are greater when particles er the tracheobronchial and alveolar (bronchial tubes and lun portions of the respiratory system. Small particles can penetrate i these deeper regions of the respiratory system. For the partic larger than 10 micrometers, healthy respiratory systems can trap particles more efficiently before they move deep into the system a can more effectively remove those that do move deep into system.

Welfare effects are those that influence one's quality of life other th human health effects. Particulate matter can form a film on pl leaves, reducing sunlight and subsequently interfering w photosynthesis. Other effects of particles include soiling a degradation of property, which can be costly in terms of cleaning a maintaining surfaces. Reduction of visibility occurs when sm particles absorb or scatter visible light. Visibility is a national conce particularly in areas such as national parks, historic sites, and sce attractions that are visited by sightseers.

III. B. Carbon Monoxide

Carbon monoxide (CO) is the most commonly occurring air pollut CO is a colorless, and poisonous gas produced by incompl burning of carbon-containing fuel. It is estimated that total C emissions to the atmosphere comprise approximately 60 percent all pollutant emissions in North Carolina.

CO Sources

Most atmospheric CO is produced by incomplete combustion of fu used for vehicles, space heating, industrial processes and solid was combustion. Transportation activities account for the majority of t CO emissions. Boilers and other fuel burning heating systems a also significant sources of CO.

CO Effects

Breathing carbon monoxide affects the oxygen carrying capacity the blood in both sick and healthy individuals. Hemoglobin in t blood attaches to CO more readily than it does to oxygen, th depriving the body of vital oxygen.

Carbon monoxide diminishes the function of even healthy individua Individuals with anemia, lung, and heart diseases are particula sensitive to CO effects. At low concentrations, mental functio vision, and alertness are affected. At high concentrations, C exposure can increase fatigue, reduce work capacity, and m adversely effect fetal development. Cardiac damage may result fro chronic exposure to CO at levels as low as 70 ppm (80 mg/m Other health effects associated with exposure to CO include centr nervous system effects and pulmonary function difficulties.

Ambient concentrations apparently do not adversely affect vegetati or materials. The effects on animals are similar to those on human

III. C. Ozone

The ozone ambient air quality standard and statewide ozone monitoring are concerned with the ozone concentrations in the lower atmosphere where we live and breathe. Ozone in the stratosphere acts to shield the earth from harmful effects of ultraviolet radiation. However, at ground level, high concentrations of ozone are a major health and environmental concern. Ozone in the lower atmosphere is harmful to people, animals, vegetation, and materials even in low concentrations. Ozone has become the most widespread and serious criteria air pollutant problem in North Carolina.

Ozone Sources

Ozone (O_3) is the major compound of the complex mixture of compounds known as photochemical oxidants. Ozone is not usually emitted directly into the atmosphere as are the other criteria g28 pollutants, but is formed by a series of complex reactions involving hydrocarbons, nitrogen oxides and sunlight. Ozone concentrations are higher during the daytime in late spring, summer and early autumn when the temperature is above 60°F and the sunlight is more intense. North Carolina's ozone season is April through October.

Two natural sources of ozone are electrical discharge during thunderstorms and solar radiation in the stratosphere. Those two sources are not believed to be significant in the lower atmosphere.

Ozone Effects

Ozone is a pulmonary irritant and affects the respiratory mucous membranes as well as other lung tissues and respiratory functions. Studies have demonstrated ozone impairment of the normal function of the lung, causing shallow, rapid breathing and a decrease in pulmonary function. Other symptoms of ozone exposure include chest tightness, coughing and wheezing. People with asthma, bronchitis, or emphysema will probably experience breathing difficulty when exposed to short-term concentrations between 0.15 and 0.25 ppm.

With continued or repeated long-term exposure, permanent lung structure damage may occur even in healthy people. Ozone has also been shown to interfere with the immune system function in animals. Recent studies have indicated that ozone concentrations of less than 0.12 ppm may have health effects on certain people. The federal EPA is continuing to evaluate the health effects data.

Ozone accelerates the aging of many materials, causing rubber cracking, dye fading, paint erosion, and plant damage. In general, ozone injury to vegetation develops initially at the tips of young leaves and becomes more widespread as the leaves mature. The most common ozone symptoms on broad-leaved plants are small flecks visible on the upper leaf surface. This problem has been severe on sensitive varieties of tobacco and is generally referred to as weather fleck.

Some of the agricultural and garden vegetation affected include tobacco, corn, soybeans, tomato, rye, wheat, beans, potatoes, melons, alfalfa, spinach, onions and grapes. Other vegetation affected includes gladiolus, azalea, eastern white pine, loblolly pine, Virginia pine, locust, white oak and poplar. Many of these plants are of economic importance in North Carolina. Adverse effects on sensitive vegetation have been observed from exposure to ozone concentrations of 0.05 ppm (100 $\mu g/m^3$) for four hours.

Good Ozone

Not all ozone is bad for us. High concentrations of ozone in the upper atmosphere protect us. Upper atmospheric ozone is needed to absorb the high energy sunlight (ultraviolet light). Without sufficient upper atmospheric ozone, more ultraviolet light will reach the surface of the earth. Too much exposure to ultraviolet light has been shown to cause skin cancer. It is believed many air pollutants are causing depletion of the upper atmospheric ozone. One type of chemical, chlorofluorocarbons, is believed to play a major part in the upper atmospheric ozone depletion. International studies and conferences are underway to develop strategies to reduce this problem.

III. D. Sulfur Dioxide

More than 90 percent of sulfur oxide emissions occur as sulfur dioxide (SO_2); the balance occurs as sulfur trioxide (SO_3) and various forms of sulfates. For this reason nearly all sulfur oxide ambient monitoring nationwide is for sulfur dioxide. It is a colorless gas that can be detected by taste at concentrations of 0.38 to 1.15 ppm.

SO_2 Sources

The main sources of SO_2 are the combustion of fossil fuels containing sulfur compounds and the manufacturing of sulfuric acid. Other sources include refining of petroleum and smelting of ores containing sulfur.

SO_2 Effects

The most obvious health effects of sulfur dioxide are irritation and inflammation of body tissues that are contacted by the gas. Sulfur dioxide can increase the severity of existing respiratory diseases such as asthma, bronchitis, or emphysema. Breathing SO_2 causes bronchial constriction, which results in increased resistance to air flow, reduction of air volume and increased respiratory rate and heart rate. Asthmatics showed increases in airway resistance after exposures of only 5 to 10 minutes of SO_2 concentrations even below 0.5 ppm (1300 $\mu g/m^3$).

The federal EPA is evaluating the health effects data and is considering adoption of a more "restrictive" short-term ambient air quality standard. Transformation products of SO_2 such as sulfuric acid aerosol and fine particulate sulfates may also cause significant health problems.

Sulfur dioxide can damage many types of vegetation. The injury symptoms usually consist of a bleaching appearance and can occur both between the veins and on the margins. Many plants of economic importance are sensitive to SO_2, including cotton, sweet potatoes, wheat, cucumber, alfalfa, peas, oats, gladiolus, tulips, blue grass, violet, zinnia, apple trees and several types of pine trees.

Another effect of SO_2 transformation products is the reduction of visibility. Sulfates are a major component of atmospheric fine particulate material, and because some sulfates absorb water, their impact on visibility is greatly increased at high humidities. Observations of widespread hazes in the eastern United States appear to be increasing with SO_2 emissions.

Another of the principal concerns is the suspected role of sulfur dioxide in causing acid rain, which is usually observed in regions of high sulfate concentrations. Acid rain can lower the pH of soils and

natural waters, cause mineral leaching, damage vegetation and deplete fish populations in some lakes.

III. E. Nitrogen Oxides

There are several oxides of nitrogen in the atmosphere, but the most prevalent ones are nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrogen oxides play a role in the formation of ozone during the summer months. For this reason, new monitoring sites are scheduled to be established in areas exceeding the ozone standard.

NO_2 Sources

The most important nitrogen oxide emissions occur as a result of man's burning of fossil fuels such as coal, oil and gasoline. Air is used to support most combustion processes. The nitrogen in air is oxidized as well as the fuel being burned which forms nitrogen oxide compounds. Nitrogen oxides are emitted from combustion sources primarily as nitric oxide (NO). Through reactions with other atmospheric compounds such as hydrocarbons and ozone, the NO is converted to nitrogen dioxide. Nitrogen dioxide may undergo further transformation into gaseous nitric acid (HNO_3) and nitrate particulates.

Recent research conducted by the Georgia Institute of Technology, has indicated that the role of nitrogen oxide compounds in the formation of ozone may be very significant. The control of NO_x emissions rather than hydrocarbon emissions, may be more effective in the control of ozone. Nitrogen oxides sources may need improved controls even though the NO_2 standard is being met.

NO_2 Effects

Nitrogen dioxide has effects on human health, especially the sensitive members of the population. Asthmatics and children are likely to be affected by NO_2 concentrations as low as 0.5 ppm. Nitrogen oxides also indirectly affect human health by their contribution to the formation of ozone.

Some types of vegetation are very sensitive to nitrogen dioxide; they include oats, alfalfa, tobacco, peas and carrots. The one primary symptom of chronic NO_2 exposure is chlorosis (yellowing), while acute NO_2 exposure usually causes the appearance of irregular shaped lesions within the leaves. Earliest indications of injury are gray-green water-soaked areas located on the upper leaf surface.

Nitrogen dioxide and particulate nitrates are among the pollutants that cause visibility impairment. In high concentrations NO_2 gas is reddish-brown and it is thought to contribute a significant portion of the brownish coloration often observed in polluted air in the colder months.

Nitrogen oxides also contribute to acid deposition by forming nitric acid. It has been estimated that nitric acid comprises approximately 25 to 30 percent of the acidity in precipitation.

III. F. Lead

Lead compounds exist in the atmosphere as gases or particles.

Lead Sources

For many years, the major source of atmospheric lead has been the combustion of leaded gasoline (tetraethyl lead is added as an antiknock agent). The continued decrease in the amount of leaded fuels and the decreased concentration of lead in those fuels, have minimized the impact of gasoline combustion as a large lead sourc

Coal combustion and lead emissions from sandblasting of bridg overpasses, and water tanks have the potential to be the mc significant sources of lead air contamination in the state. Lead exis in very small quantities as an impurity in coal. A portion of the le from coal combustion is collected by control equipment on lar boilers. The Department of Transportation (DOT) is studying wa to reduce lead emissions from sandblasting of bridges a overpasses.

Other sources of lead include battery manufacturers. Lead is al used in paints, insecticides and newspaper inks.

Lead Effects

Lead (Pb) persists and accumulates in the environment and in t human body. It enters the body through eating and breathing and eventually absorbed into the blood stream and distributed to all bo tissues. Exposure to low concentrations interferes with specif enzyme systems and blood production. It is also believed to be cause of kidney and nerve cell damage.

Brain damage has been documented in cases of severe le poisoning in children. Also noted were headaches, restlessnes tremors, and general symptoms of mental retardation. Convulsio are not uncommon and may be followed by coma. People greatest risk include battery workers, solderers, sandblasters, a small children who play near lead sources.

IV. Ambient Air Monitoring Program Description

Ambient monitoring and analysis of samples were conducted by t Division of Environmental Management and four local air polluti control programs. These programs are listed in Appendix A. T collected air monitoring data are used to determine if air qua standards are being met, to assist in enforcement actions, determine the improvement or decline of air quality and to determi the extent of allowable industrial expansion. The sites are listed alphabetic order by county in Table X at the end of this section. map showing the general locations of the ambient air monitoring sit is shown in Figure 14.

Specific monitor siting involves considerations such as size of t area represented, distance from roadways and nearby source unrestricted air flow, safety, availability of electricity and security.

All sites have a defined monitoring objective and annual evaluatio are made to ensure that the objectives are met. The four ba monitoring objectives are:

1. to determine the highest concentration expected in an area,

2. to determine representative concentrations in areas of hi population density,

3. to determine the impact of significant sources or source categori on ambient air quality, and

4. to determine general background concentration levels.

All monitors have known precision, accuracy, interferences a operational parameters. The monitors, as well as all measureme devices, are carefully calibrated at predetermined frequenci

varying from daily to quarterly. Measurements are traceable to the National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) when standards are available.

Standard operating procedures are followed in monitoring and analyses. Field personnel visit the manual sites once every sixth day to replace sample media and check the operation and calibration of the monitors. Continuous monitors are checked at least twice weekly for correct instrument operation.

Quality assurance activities determine the quality of the collected ambient data, improve the quality of the data and evaluate how well the monitoring system operates. The objectives of the quality assurance activities are to produce high quality air pollution data with defined completeness, precision, accuracy, representativeness and comparability.

At most sites, microprocessors are being used to collect the data. The system assembles the data for submission to the US Environmental Protection Agency. This enhances data validity, minimizes travel cost, and allows real-time data to be available by computer polling when needed. Numerous checks are performed to ensure that only valid data are reported.

V. AIR QUALITY INDEX

In addition to this annual data report, up-to-date air quality information is available 24-hours a day in four areas of the state through the use of the air quality index (AQI) telephone numbers. These numbers are listed below:

Charlotte	704-333-SMOG
Durham	919-733-DATA
Fayetteville	919-486-9413
Raleigh	919-733-DATA

Citizens of these areas can check the quality of the air in their area on a nearly real-time basis by calling the listed telephone number. The Durham AQI is included as a part of the Raleigh AQI and is a long distance call from Durham, but the other numbers are local calls from the respective areas.

When any of the numbers are called, a recorded message will provide the current air quality report, which is updated every four hours based on information from the local area air pollutant monitors.

The report provides the air quality index for the pollutant with the highest concentration and a word describing the expected effect of the pollutant on human health. The descriptions are good, moderate, unhealthful, very unhealthful, and hazardous. Index levels do not normally exceed the unhealthful range (AQI>199), with most reports in the good-moderate range, between zero and 100. A nationwide method of assigning the index numbers is used so travelers from other parts of the country can interpret a local index.

The index rates the air quality from zero to 500. Index numbers of zero to 49 are considered good and indexes of 50-99 are considered moderate with no adverse health effects expected and no protective actions recommended.

An index of 100-199 is described as unhealthful and can produce mild aggravation of symptoms in susceptible persons and possible irritation in healthy persons. People with existing heart or lung ailments should reduce physical exertion and outdoor activity when the index is in this range.

Ratings of 200 to 299 are considered very unhealthful and can produce significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease. A variety of symptoms may occur in healthy persons. Elderly people and those with existing heart or lung problems should stay indoors and reduce physical activity.

An index above 299 is considered hazardous. When an index ranges from 300 to 399, premature onset of certain diseases can be expected in addition to significant aggravation of symptoms and decreased exercise capability in healthy persons. Elderly people and individuals with existing diseases should stay indoors and avoid physical exertion. The general population should avoid outdoor activity when the air quality index exceeds 299.

An index between 400 and 500 can be expected to cause premature death of ill and elderly people. Healthy persons will experience adverse symptoms that affect their normal activity. All persons should remain indoors, keeping windows and doors closed, and everyone should minimize physical exertion and avoid motor vehicle traffic.

An example of an Air Quality Index Report is as follows:

"This is the North Carolina Department of Environment, Health and Natural Resources Air Quality Report.

The air quality index for most of Cumberland County is 88 for the four-hour period ending at 12 noon. This index is regarded as moderate. The responsible pollutant is ozone.

This report will be updated at 4 pm. Thank you for calling."

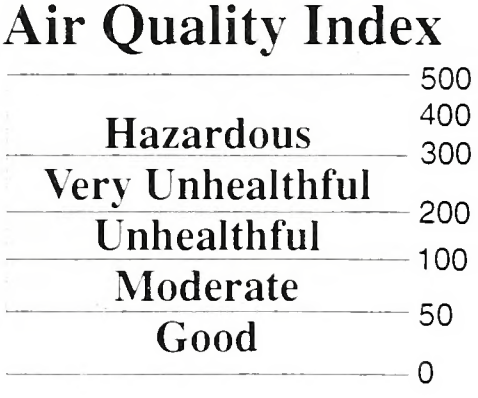


Figure 14
Locations of Monitoring Sites

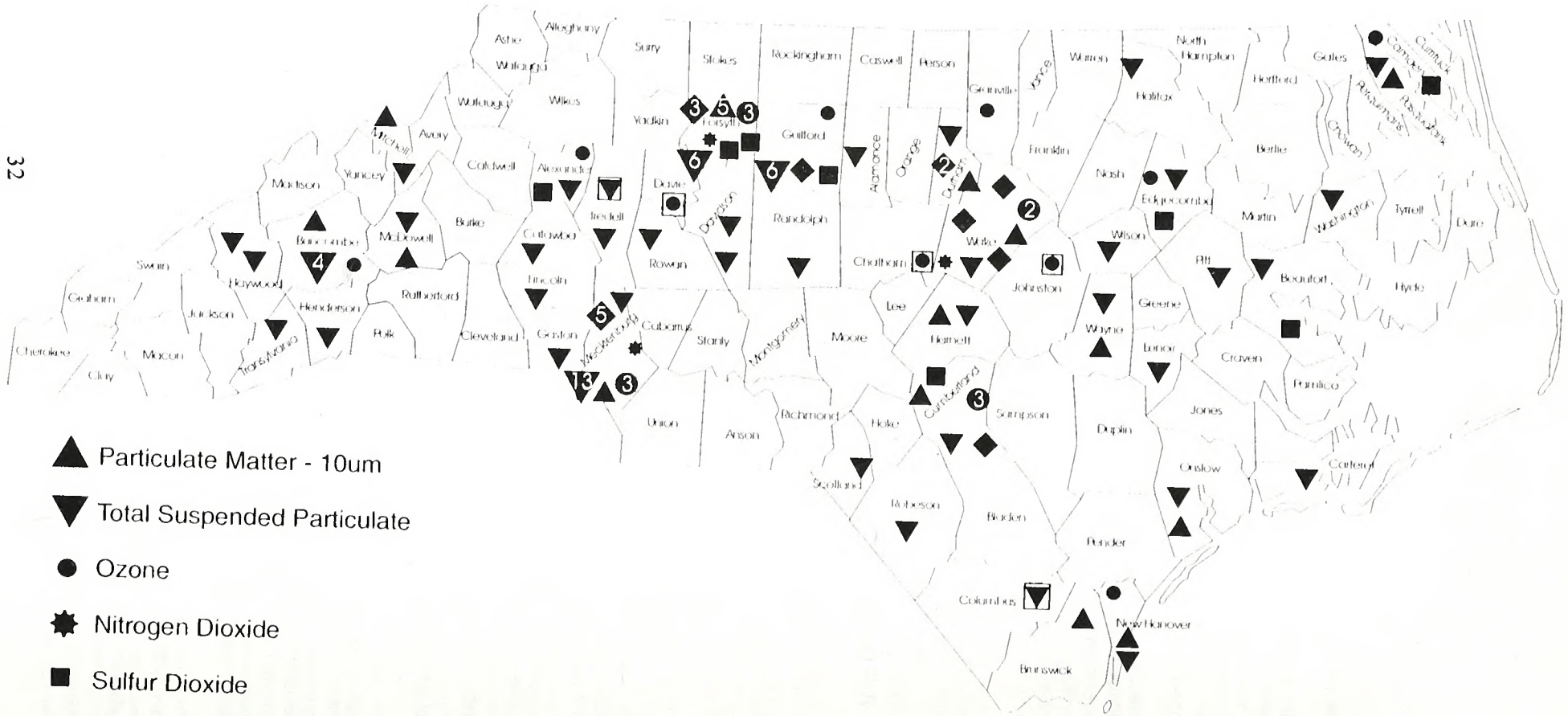


TABLE X: North Carolina Ambient Air Monitoring Sites Operating in 1990

County	Site	Site Number	Pollutant(s)
Alamance	Burlington, 1136 E. Webb Ave.	37-001-0001	TSP
Alexander	Taylorsville, SR 1107 & 1117	37-003-0003	TSP, O_3, SO_2
Beaufort	Aurora, NC HWY 306	37-013-0003	SO_2
Beaufort	Washington, 400 E. Third St.	37-013-1003	TSP
Brunswick	Shallotte, State Road 1163	37-019-0004	PM-10
Buncombe	Airport, Airport Rd.	37-021-0025	TSP
Buncombe	Asheville Health & Welfare Bldg.	37-021-0003	TSP, PM-10
Buncombe	Candler, Candler	37-021-0027	TSP
Buncombe	Asheville, Rt. 191 S. Brevard Rd.	37-021-0030	O_3
Buncombe	Grove Stone, Grove Stone	37-021-0026	TSP
Cabarrus	Kannapolis, Floyd St.	37-025-0004	TSP
Caldwell	Lenoir, HWY 321 N.	37-027-0003	TSP
Camden	Camden, County Rd. 1136	37-029-0099	SO_2, O_3
Carteret	Morehead City, Arendell & 4th	37-031-0003	TSP
Catawba	Hickory, 1650 1st Street	37-035-0004	TSP
Columbus	Acme, Acme-Delco	37-047-0001	TSP, SO_2
Cumberland	Eastover, Old U.S. Hwy 301	37-051-0001	O_3
Cumberland	SR1857/US 3	37-051-0008	O_3
Cumberland	Hope Mills, Rockfish Rd., Police Station	37-051-1002	O_3, SO_2
Cumberland	Fayetteville, 3296 Village Dr.	37-051-0004	TSP, PM-10
Cumberland	Fayetteville, ABC Board	37-051-0007	CO
Davidson	Lexington, S. Salisbury St.	37-057-0002	TSP
Davidson	Thomasville, City Hall 7 W. Guilford	37-057-1001	TSP
Durham	Durham, Old Sears Bldg, Dillard & Main St.	37-063-0001	TSP, PM-10
Durham	Durham, Old Health, Roxboro Rd. & Main St.	37-063-0008	CO
Durham	Durham Park, 1639 University Dr.	37-063-0010	CO
Edgecombe	Rocky Mount, Leggett Rd. WTP	37-065-0002	TSP
Edgecombe	Rt. 2, Box 195, Tarboro	37-065-0099	O_3, SO_2
Forsyth	Kernersville, Bodeheimer St.	37-067-1001	TSP, PM-10
Forsyth	Walkertown, Grubbs Rd.	37-067-0001	TSP
Forsyth	Belews Creek Rd., Goodwill Church	37-067-0006	O_3
Forsyth	Winston-Salem, Ferguson Sch., 5337 Old Rural	37-067-0007	SO_2, NO_2, O_3
Forsyth	Winston-Salem, Friends Church, Sixth & Broad	37-067-0021	TSP
Forsyth	Winston-Salem, 1401 Corporation Parkway	37-067-0023	CO, TSP, PM-10

Forsyth	Winston-Salem, Hanes Park, Indiana Ave.	37-067-0009	PM-10
Forsyth	Winston-Salem, Main St.	37-067-0018	CO
Forsyth	Winston-Salem, Queen St. & Leisure Lane	37-067-0019	CO
Forsyth	Winston-Salem, 720 Ridge Ave.	37-067-0013	TSP, PM-10
Forsyth	Winston-Salem, Silas Creek Pkwy	37-067-0020	TSP, PM-10
Forsyth	Winston-Salem 13th & Hattie St.	37-067-0022	SO_2, NO_2
Forsyth	Winston-Salem, 3656 Piedmont Memorial Dr.	37-067-1008	O_3
Gaston	Gastonia, Rankin Lake Rd.	37-071-0014	TSP
Granville	Butner, Water Treatment Plant	37-077-0001	O_3
Guilford	Greensboro, Edgeworth & Bellemeade St. (Western Guilford High School)	37-081-0009	TSP, PM-10
Guilford	Greensboro, 409 Friendway Dr.	37-081-0012	TSP
Guilford	Greensboro, 1305 Merritt Dr.	37-081-0010	TSP, SO_2
Guilford	High Point, 650 Francis St.	37-081-0004	TSP
Guilford	High Point, National Guard Armory 2210	37-081-1003	TSP
Guilford	High Point, East Green & S. Centennial	37-081-1005	TSP
Guilford	McLeansville, Keely Park	37-081-0011	O_3
Guilford	Greensboro, Latham Park, 401 W. Wendover	37-081-1011	CO
Halifax	Roanoke Rapids, NE Corner of 5th & Carolina	37-083-0002	TSP
Harnett	Dunn, Municipal Bldg.	37-085-0001	TSP, PM-10
Haywood	Canton, Canton Fire Dept.	37-087-0002	TSP
Haywood	Hazelwood, Brown Ave.	37-087-0006	TSP
Henderson	Hendersonville, US 25 & US 64	37-089-1005	TSP
Johnston	Highway 301, Micro	37-101-0099	O_3, SO_2
Lenoir	Kinston, 1700 Market St.	37-107-0003	TSP
Lincoln	Lincolnton, Jail	37-109-0002	TSP
McDowell	Marion, Courthouse	37-111-0002	TSP, PM-10
Mecklenburg	Arrowood, 400 Westinghouse Blvd.	37-119-1005	TSP, O_3
Mecklenburg	Cabarrus Co. Line, 29 N.	37-119-1009	O_3
Mecklenburg	Charlotte, Central Ave.	37-119-0032	CO
Mecklenburg	Charlotte, 600 E. Trade St.	37-119-0001	TSP
Mecklenburg	Charlotte, 800 S. Graham St.	37-119-0002	TSP
Mecklenburg	Charlotte, Co. Health Dept., 1200 Blyth	37-119-0011	TSP
Mecklenburg	Charlotte, 2136 Remount Rd.	37-119-0010	TSP, PM-10
Mecklenburg	Charlotte, 620 Moretz St.	37-119-0003	TSP
Mecklenburg	Charlotte, Greenville Neighborhood Ctr.	37-119-0035	CO

Mecklenburg	Charlotte, 1501 N I-85	37-119-0028	TSP
Mecklenburg	Charlotte, 415 E. Woodlawn	37-119-0037	CO
Mecklenburg	Charlotte, 301 N. Tryon St.	37-119-0038	CO
Mecklenburg	Charlotte, Plaza Rd. & Lakedale	37-119-0034	CO, O_3, NO_2
Mecklenburg	Charlotte, Woodlawn VFD	37-119-0026	TSP
Mecklenburg	Charlotte, W. Mecklenburg, 7400 Tuckasegee	37-119-0901	TSP
Mecklenburg	Davidson, Filter Plant	37-119-1001	TSP
Mecklenburg	Duke Power, Neck Road	37-119-1006	TSP
Mecklenburg	Huntersville, Holbrook Rd.	37-119-1003	TSP
Mecklenburg	Mint Hill, Telephone Substation	37-119-2001	TSP
Mitchell	Spruce Pine, Summit St.	37-121-0001	TSP, PM-10
New Hanover	Wilmington, Ninth & Orange	37-129-0005	TSP, PM-10
New Hanover	SR1002	37-129-0002	O_3
Onslow	Jacksonville, 2553 Onslow Dr.	37-133-0004	TSP, PM-10
Pasquotank	Elizabeth City, N. Wilson St.	37-139-0001	TSP, PM-10
Pitt	Greenville, 1500 Beatty St.	37-147-0003	TSP
Randolph	Asheboro, 1462 Winslow St.	37-151-0003	TSP
Robeson	Lumberton, S. Water St.	37-155-0003	TSP
Rowan	Salisbury, Church St.	37-159-1005	TSP
Scotland	Laurinburg, Laurinburg WTP	37-165-0003	TSP
Transylvania	Brevard, HWY 64	37-175-0002	TSP
Wake	Raleigh, Crabtree HWY 70 West	37-183-0013	CO
Wake	Raleigh, Person St., 420 S. Person St.	37-183-0011	CO
Wake	Raleigh, North Hills, Six Forks Rd	37-183-0003	TSP, PM-10
Wake	Raleigh, 309 S. Wilmington St	37-183-0010	CO
Wake	Raleigh, E. Millbrook Junior High	37-183-0014	O_3, NO_2
Wake	Wake Forest, HWY 98 Wake Forest Rd.	37-183-2001	O_3
Washington	Plymouth, Old Acre Rd.	37-187-0002	TSP
Wayne	Goldsboro, HWY 70 W. Patrol Sta.	37-191-0004	TSP, PM-10
Wilson	Wilson, N.W. Corner of Kenan & Pine St.	37-195-0002	TSP

VI. ACID RAIN

Acid rain is produced when nitrate and sulfate ions from automobile and industrial sources are released into the upper atmosphere, undergo a reaction with moisture in the air and are deposited as acid precipitation. Acid ions are produced when sulfur dioxide and nitrogen oxides reach equilibrium with water to form sulfuric acid and nitric acid.

Many crops in North Carolina are sensitive to rain precipitation which is considered more acidic than "normal." Forests are subject to mineral loss from acid rain exposure and may also suffer root damage. Acid fogs and mists, typical in the mountains of North Carolina, can expose trees and plants to even higher acid concentrations and cause direct damage to foliage. Lakes, rivers and streams that are too acidic impede fish and plant growth.

Since 1978, routine acid rain monitoring has been performed in North Carolina and the nation by the National Atmospheric Deposition (NADP) and the National Trends Network (NTN) which merged with NADP in 1982.

There are seven NADP/NTN monitoring sites in North Carolina and two mountain sites within 10 miles of the North Carolina's western border. EPA's National Dry Deposition Network (NDDN) shares one of these sites as a collocated site with NADP/NTN at Coweeta, North Carolina. There is also an NDDN site in Cranberry near Boone. An NDDN site at Candor near Troy is slated for 1991 operation. The data from these sites are shown in Table XI and Figure 15.

Acid deposition monitoring is conducted using a wet/dry bucket type sampler. When rain begins to fall, a sensor is activated and an automatic metal lid covers and protects the dry sample, leaving the "wet" bucket exposed to collect precipitation.

Acid precipitation is measured using a "pH scale" which is mathematical term for the negative logarithm of the hydronium ic concentration of water. The hydronium ion is measured on a sca from 1 to 14, with 1 being extremely acidic and 14 being extreme basic. Vinegar has a pH of approximately 2.8, lemon juice has a p of approximately 2.3 and ammonia has a pH of approximately 12.

A neutral water sample, with equal acid and base ions has a pH of Pure water in equilibrium with the air is slightly acidic and has a pH approximately 5.6. The logarithmic scale is measured in orders magnitude - such that a pH of 6 is ten times more acidic than a p of 7. A pH of 9 is one hundred times more basic than a pH of 7.

In 1990, the average annual pH of rainfall for the acid rain monito operated by the NADP/NTN/NDDN in North Carolina range between 4.4 and 4.8, or about ten times more acidic than "norma Some rainfalls have been more that one hundred times more acid than normal.

The annual pH average for the nine sites in and around Nor Carolina for 1990 is 4.56.

Monitoring for acid rain will help to identify atmospheric depositic trends. Hopefully continued monitoring will reflect efforts mac towards reduction of sulfates and nitrates from mobile and industri sources.

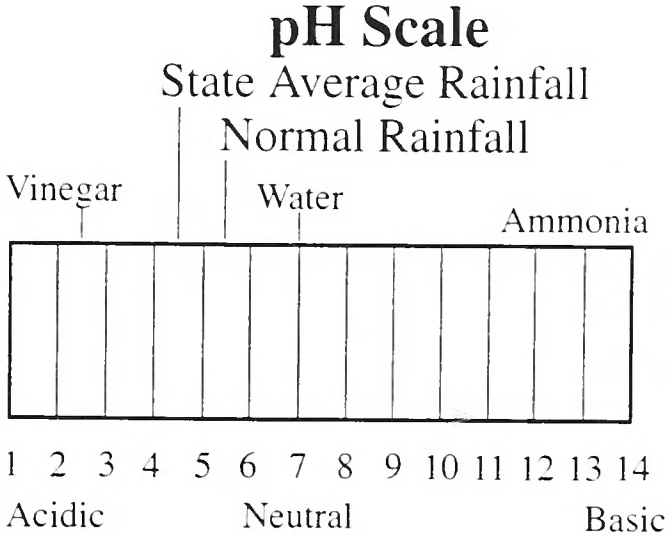


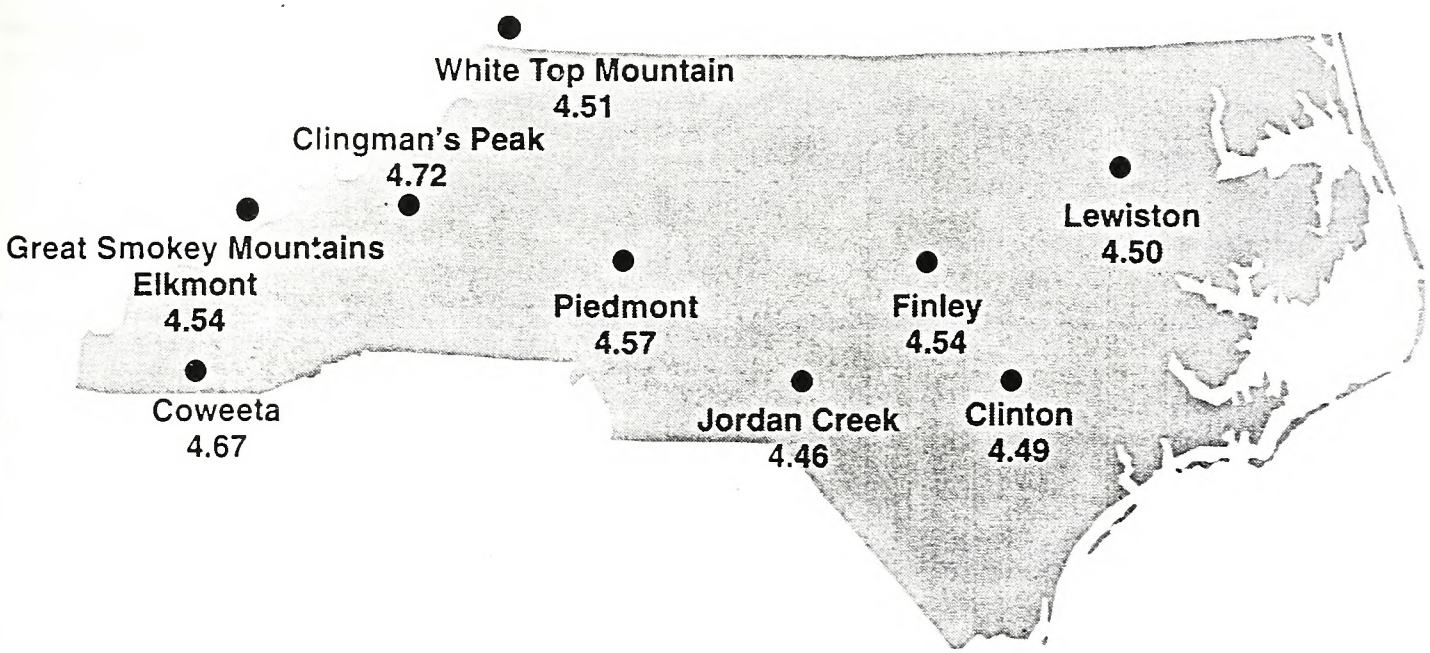
TABLE XI: 1990 NATIONAL ATMOSPHERIC DEPOSITION PROGRAM/NATIONAL TRENDS NETWORK

Milligrams per Liter

County	Site	% Comp[1]	Ca	Mg	K	Na	NH4	NO3	Cl	SO4	pH	Cond.[2]	CM
Wake	Finley	96	.06	.04	.08	.24	.32	.99	.43	1.75	4.54	18.2	102.0
Yancey	Clingman	49	.03	.01	.01	.06	.14	.51	.12	1.05	4.72	11.0	182.1
Sevier, Tn.	Elkmont	92	.07	.01	.03	.06	.19	.82	.13	1.54	4.54	15.9	161.0
Smyth, Va.	WhiteTop Mount.	63	.06	.01	.01	.05	.22	.81	.10	1.70	4.51	16.9	114.3
Scotland	Jordan Creek	92	.08	.05	.03	.34	.21	1.08	.61	1.81	4.46	20.9	108.0
Sampson	Clinton	100	.08	.05	.03	.37	.29	1.08	.67	1.86	4.49	20.7	93.1
Rowan	Piedmont	87	.08	.04	.05	.20	.31	.99	.36	1.68	4.57	17.6	124.0
Macon	Coweeta[+]	90	.04	.02	.02	.13	.16	.61	.24	1.14	4.67	12.5	209.5
Bertie	Lewiston	96	.07	.04	.03	.25	.22	.93	.46	1.69	4.50	18.9	109.8

+ NDDN sites
1 Completeness
2 Conductivity

Figure 15
pH values of North Carolina NADP/NTN/NDDN sites for 1990



10/16/95

Appendix A
AIR POLLUTION MONITORING AGENCIES
(May 1991)

NORTH CAROLINA HEADQUARTERS

Division of Environmental Management
Archdale Building
512 North Salisbury Street
P O Box 29535
Raleigh, North Carolina 27604
(919) 733-3340

NORTH CAROLINA REGIONAL OFFICES

Asheville Regional Office
Interchange Building
59 Woodfin Place
Asheville, North Carolina 28801
(704) 251-6208

(Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, P
Rutherford, Swain, Transylvania, and Yancey Counties)

Fayetteville Regional Office
Wachovia Building
Suite 714
Fayetteville, North Carolina 28301
(910) 486-1541

(Anson, Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Robeson, Richmond, Sampson, and Scotland Counties)

Mooresville Regional Office
919 N. Main Street
Mooresville, North Carolina 28115
(704) 663-1699

(Alexander, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, and Union Counties)

Raleigh Regional Office
3800 Barrett Drive
PO Box 27687
Raleigh, North Carolina 27611
(919) 571-4700

(Chatham, Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northhampton, Orange, Person, Vance, Wake, Warren, a
Wilson Counties)

Washington Regional Office
1424 Carolina Avenue
Washington, North Carolina 27889
(919) 946-6481

(Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotar
Perquimans, Pitt, Tyrrell, Washington, and Wayne Counties)

Wilmington Regional Office
127 Cardinal Drive Extension
Wilmington, North Carolina 28405-3345
(910)-395-3900

(Brunswick, Carteret, Columbus, Duplin, New Hanover, Onslow and Pender Counties)

Winston-Salem Regional Office
585 Waughtown Street
Winston-Salem, North Carolina 27107
(910) 771-4600

(Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Rockingham, Randolph, Stokes, Surry, Yadkin, Watauga and Wilkes Counties)

LOCAL AGENCIES

Western North Carolina Regional Air Pollution Control Agency
(Buncombe & Haywood Counties)
Buncombe County Courthouse Annex
Asheville, North Carolina 28801-3569
(704) 255-5655

Forsyth County Environmental Affairs Department
(Forsyth County)
537 North Spruce Street
Winston-Salem, North Carolina 27101
(919) 727-8091

Mecklenburg County Department of Environmental Protection
(Mecklenburg County)
700 North Tryon Street
Charlotte, North Carolina 28202-2236
(704) 336-5463

Guilford County Department of Environmental Health*
(Guilford County)
301 North Eugene Street
Greensboro, North Carolina 27401
(919) 373-3771

*Monitoring activities were transferred to the Winston-Salem Regional Office in January of 1991. The Guilford County local agency ceased monitoring activities in December of 1990.

Appendix B

EXCEPTIONAL EVENTS

1. **Natural Events**
   - Sustained high windspeeds (PM)*
   - Stagnations/inversions (all pollutants)
   - Unusual lack of precipitation (PM)
   - Stratospheric ozone intrusion (O_3)
   - Volcanic eruption (CO, SO_2, PM)
   - Forest fires (CO, PM)
   - High pollen count (PM)

2. **Unintentional Man-made Events**
   - Large accidental structural fires (CO, PM)
   - Major traffic congestion due to accident or nonrecurring obstruction (CO)
   - Chemical spills (SO_2, NO_2, PM, CO)
   - Industrial accidents (SO_2, NO_2, PM, CO)

3. **Intentional Man-made Events**
   - Short-term construction/demolition (PM)
   - Sandblasting (PM)
   - High-sulfur oil refining (SO_2)
   - Roofing operations (PM, SO_2)
   - Salting or sanding of streets (PM)
   - Infrequent large gatherings (PM, CO)
   - Soot blowing from ships (PM)
   - Agricultural tilling (PM)
   - Prescribed burning (CO, PM)
   - Noncompliance–local source (CO, SO_2)

PM = particulate matter results affected
CO = carbon monoxide results affected
NO_2 = nitrogen dioxide results affected
SO_2 = sulfur dioxide results affected
O_3 = ozone results affected

APPENDIX C

NONATTAINMENT AND NORTH CAROLINA

What is nonattainment and what are the sources of the pollutants?

The United States Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards. North Carolina monitors concentrations of air pollutants in the ambient air. Some of these monitors have measured concentrations of ozone and carbon monoxide exceeding the Standards. Areas that have not met the National Ambient Air Quality Standards can be classified by EPA as "nonattainment."

Mobile sources are the primary cause of carbon monoxide and ozone precursors. Around 90 percent of the carbon monoxide emissions come from motor vehicles. Thirty percent to 50 percent of the man-made hydrocarbons or volatile organic compound emissions come from motor vehicles; the rest comes from petroleum marketing, factories, businesses, and households. Volatile organic compounds react with nitrogen oxides and sunlight in warm weather to produce ozone.

Why is my county nonattainment?

Unless the state can demonstrate a better alternative, EPA has indicated that they will designate nonattainment areas based on Metropolitan Statistical Areas (MSAs). These MSAs were established by the Office of Management and Budget. Monitors showing violations of Standards may not be in every county. Previous emission control programs instituted in single counties across the nation have often failed to produce compliance with Standards. Pollution from one county blows into neighboring counties (especially ozone). EPA concluded that the control plans must cover metropolitan areas, not single counties.

Once we are nonattainment, what is the process for becoming attainment?

North Carolina is required by the federal Clean Air Act and EPA to produce and implement emission reduction plans and show that these plans are strong enough to produce compliance with the Standards. The plans could involve resource-intensive monitoring, emissions inventory, modeling, public participation, and strategy formulation efforts. There are deadlines for producing the plans and for achieving compliance with the Standards. EPA must approve the plans.

How does the public get involved in the formulation of the emission reduction plans, known as State Implementation Plan (SIP) revisions?

Local agencies and officials, as well as state agencies, will be involved in drawing up the SIP revisions. It is likely that there will be public meetings or ad hoc citizen panels. When draft SIP revisions are done, there will be public hearings on them. The SIP revisions must be approved by the Environmental Management Commission and possibly by local bodies as well. EPA's approval process includes an opportunity for public comment.

How will it affect the citizen?

Emission reduction strategies fall into several categories. Motor vehicle inspection/maintenance may be required for hydrocarbons or carbon monoxide or both. Traffic patterns may be altered by changing roads or traffic signals. Both new and existing factories and business may have to reduce emissions by installing control equipment or changing processes. This might include requiring that gas stations trap vapors that escape when a vehicle is refueled or that gasoline contain pollution-reducing additives.

What happens if North Carolina refuses to address these air pollution problems?

Under the Clean Air Act, EPA has the authority to apply sanctions. EPA can ban the construction of major pollutant sources, and may withhold federal highway construction funds in the nonattainment areas.

What is the likelihood of receiving sanctions if we are showing progress in reducing pollution?

If North Carolina were to produce SIP revisions that EPA can approve by the deadlines and were to carry out those plans, sanctions could be avoided. If pollution concentrations did not recede and attain the Standards as projected, construction bans could be imposed. EPA has some discretion about imposing sanctions. Sanctions are a last step to persuade states to take required positive action.

What does inspection/maintenance cost?

The inspection/maintenance (I/M) of motor vehicle tailpipe testing process costs the motorist $ 15.40 as of October 1, 1990. If a vehicle fails the test, it must be repaired. A waiver is available if a vehicle still fails after $50.00 worth of repairs have been done. The $50.00 limit does not apply to tampered or misfueled vehicles. The inspection/maintenance program includes tests for hydrocarbon (HC) and carbon monoxide (CO) emissions. Currently Mecklenburg and Wake Counties have I/M programs. Testing for HC began in April of 1991. Guilford and Forsyth counties start I/M programs in July of 1991. Only gasoline powered motor vehicles built after 1974, excluding the current model year and motorcycles, are inspected in these counties. Inspection/maintenance pass-fail levels vary with vehicle age and pollutant.

Appendix D

OZONE EXCEEDANCES IN THE LAST THREE YEARS*

SITE NAME / NUMBER	CONC PPM	1988 DATE	NUM EXCD	CONC PPM	1989 DATE	NUM EXCD	CONC PPM	1990 DATE	NUM EXCD	EXCEEDANCE TOTAL 3-YR
STATE AGENCY SITES										
Butner (Durham)	0.137	6-22	6	0.133	7-11	3			0	9
37-077-0001 SLAMS	0.128	7-07		0.129	6-26					
	0.132	7-09		0.127	6-27					
	0.128	8-17								
	0.131	8-19								
	0.129	8.26								
Eastover(Fayetteville)	0.133	5-31	3			0			0	3
37-051-0001 NAMS	0.130	6-01								
	0.141	6.02								
Farmville (Pitt County)										
37-147-0099SPM	0.125	6-08	1			0	NOT OPERATING			1
Fork (Davie County)	0.126	6-14	7	NOT OPERATING			NOT OPERATING			7
37-059-0099 SPM	0.145	7-07								
	0.153	7-08								
	0.151	7-09								
	0.135	7-10								
	0.125	7-16								
	0.139	8-17								
Iron Station (Lincoln Co.)	0.126	7-07	2	NOT OPERATING			NOT OPERATING			2
37-109-0099 SPM	0.141	7-08								
McLeansville (Greensboro)	0.139	6-08	8			0	0.127	6-28	1	9
37-081-0011 SLAMS	0.132	6-22								
	0.144	7-07								
	0.144	7-08								
	0.131	7-09								
	0.128	7-10								
	0.150	7-16								
	0.144	8-19								
Wake Forest (Raleigh)	0.137	6-01	10			0			0	10
37-183-2001 NAMS	0.157	6-08								
	0.126	6-13								
	0.125	6-21								
	0.141	6-22								
	0.137	6-23								
	0.142	7-07								
	0.140	7-09								
	0.135	8-18								
	0.159	8-19								
Millbrook (Raleigh)	Not Operating					0			0	0
37-183-0014 NAMS										
STATE AGENCY TOTALS			37			3			1	41

(Continued)

* For a complete listing of ozone sites for 1990, see TABLE VI.

Appendix D

OZONE EXCEEDANCES IN THE LAST THREE YEARS*

SITE NAME/NUMBER	CONC PPM	1988 DATE	NUM EXCD	CONC PPM	1989 DATE	NUM EXCD	CONC PPM	1990 DATE	NUM EXCD	EXCEEDANCE 3-YR TOTAL
LOCAL AGENCY SITES										
Arrowood (Mecklenburg)	0.130	6-01	8			0			0	8
37-119-1005 SLAMS	0.149	6-08								
	0.140	6-13								
	0.137	6-21								
	0.143	7-07								
	0.167	7-08								
	0.125	7-15								
	0.158	8-18								
CountyLine(Mecklenburg)	0.132	6-08	9	0.147	8-04	2	0.152	7-10	1	12
37-119-1009 NAMS	0.126	6-16		0.132	6-01					
	0.144	6-17								
	0.127	7-07								
	0.169	7-08								
	0.127	7-09								
	0.156	7-10								
	0.134	8-18								
	0.126	9-14								
Plaza (Mecklenburg)	0.169	6-08	7	0.162	8-04	1			0	8
37-119-0034 NAMS	0.148	6-17								
	0.131	6-22								
	0.125	7-07								
	0.158	7-08								
	0.126	7-10								
	0.158	8-18								
Belews Creek (Forsyth)	0.142	6-14	3			0			0	3
37-067-0006 SLAMS	0.137	7-07								
	0.128	7-09								
Ferguson School (Forsyth)										
37-067-0007 SLAMS	0.134	6-14	3			0	0.133	8-03	1	4
	0.137	7-07								
	0.134	7-09								
Union Cross (Forsyth)	0.128	7-07	2			0			0	2
37-067-1008 SLAMS	0.138	7-08								
LOCAL AGENGY TOTALS			32			3			2	37
ALL STATE TOTALS			69			6			3	78

*For a complete listing of ozone sites for 1990, see TABLE VI.

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